



# **UNITED STATES AIR FORCE**

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## **SCOTT AIR FORCE BASE ILLINOIS**

### **AIR MOBILITY COMMAND**

#### **SECOND DRAFT SAMPLING & ANALYSIS PLAN STAGE II**

#### **REMEDIAL INVESTIGATION FEASIBILITY STUDY TREATABILITY STUDY**

**MARCH 1993**

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## 1.0 QUALITY ASSURANCE PROJECT PLAN (QAPP)

### 1.1 INTRODUCTION

This Remedial Investigation (RI) Quality Assurance Project Plan (QAPP) is provided in support of the United States Air Force (USAF) Installation Restoration Program (IRP) for eight sites located at Scott Air Force Base (AFB), Illinois. This investigation will adhere to those procedures specified in the Handbook to Support the Installation Restoration Program (IRP) Statements of Work, IRP Division Staff, May 1991 (Reprint).

#### 1.1.1 The U.S. Air Force Installation Restoration Program

The objective of the Air Force IRP is to assess past hazardous waste disposal and spill sites at Air Force installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which present a threat to human health and welfare or the environment. This objective is achieved through a staged Remedial Investigation/ Feasibility Study (RI/FS) process, ultimately from which are obtained conclusions and recommendations regarding remedial measures. This document provides descriptions of, or references to, data quality objectives (DQOs) and procedures associated with:

- sample collection
- laboratory analysis
- sample custody
- internal and continuing instrument/equipment calibration
- internal quality control (QC) checks
- performance and system audits
- preventative maintenance and scheduling
- data quality assessment

- corrective action
- quality assurance (QA) reports

#### 1.1.2 Purpose and Scope

The Sampling and Analysis Plan (SAP) prescribes those procedures necessary to perform a quality controlled sampling effort during the execution of the project's scope of work. The activities addressed by the SAP include:

- Installation of monitoring wells
- Soil borings
- Soil-gas survey
- Hydropunch survey
- Acquisition of ground-water, subsurface and surface soil, surface water and sediment samples
- Decontamination of equipment
- Calibration of field instruments
- Aquifer testing
- Maintenance of laboratory and field QA/QC

#### 1.2 PROJECT DESCRIPTION

The RI for Scott AFB includes eight sites: the Landfill; Fire Protection Training Areas (FPTA) 1, 2 and 3; Facility 8550; Facility 1965; the Sludge Weathering Lagoon; and Building 1680. The RI for each site is designed to delineate the vertical and horizontal extent of contamination and to collect data to characterize environmental conditions and quantitatively estimate the risk to human health and to the environment. The following sections describe the site-specific background and history.



### 1.2.1 Project Background

Scott AFB is located in western Illinois, approximately 20 miles southeast of St. Louis, Missouri. The base is bordered by agricultural land on all sides and comprises 2,503 acres.

Scott AFB was established in 1917 for the training of airplane pilots. In 1920, Scott Field was designated as a lighter-than-air station, with dirigible airships and balloons assigned to the field. In the early 1930s, the 15th Observation Squadron was assigned to Scott. With this assignment came the closure of lighter-than-air activities; the closure was final in 1937.

A new construction program began in 1938. With this program came the destruction of earlier structures (World War I and lighter-than-air era). Four concrete runways were constructed in the early 1940s. Scott was a Communications Training Center during World War II, with the majority of airborne duty operators/mechanics receiving training. Air Training Command Headquarters was transferred to Scott AFB in 1949, and remained the training center through the mid-1950s.

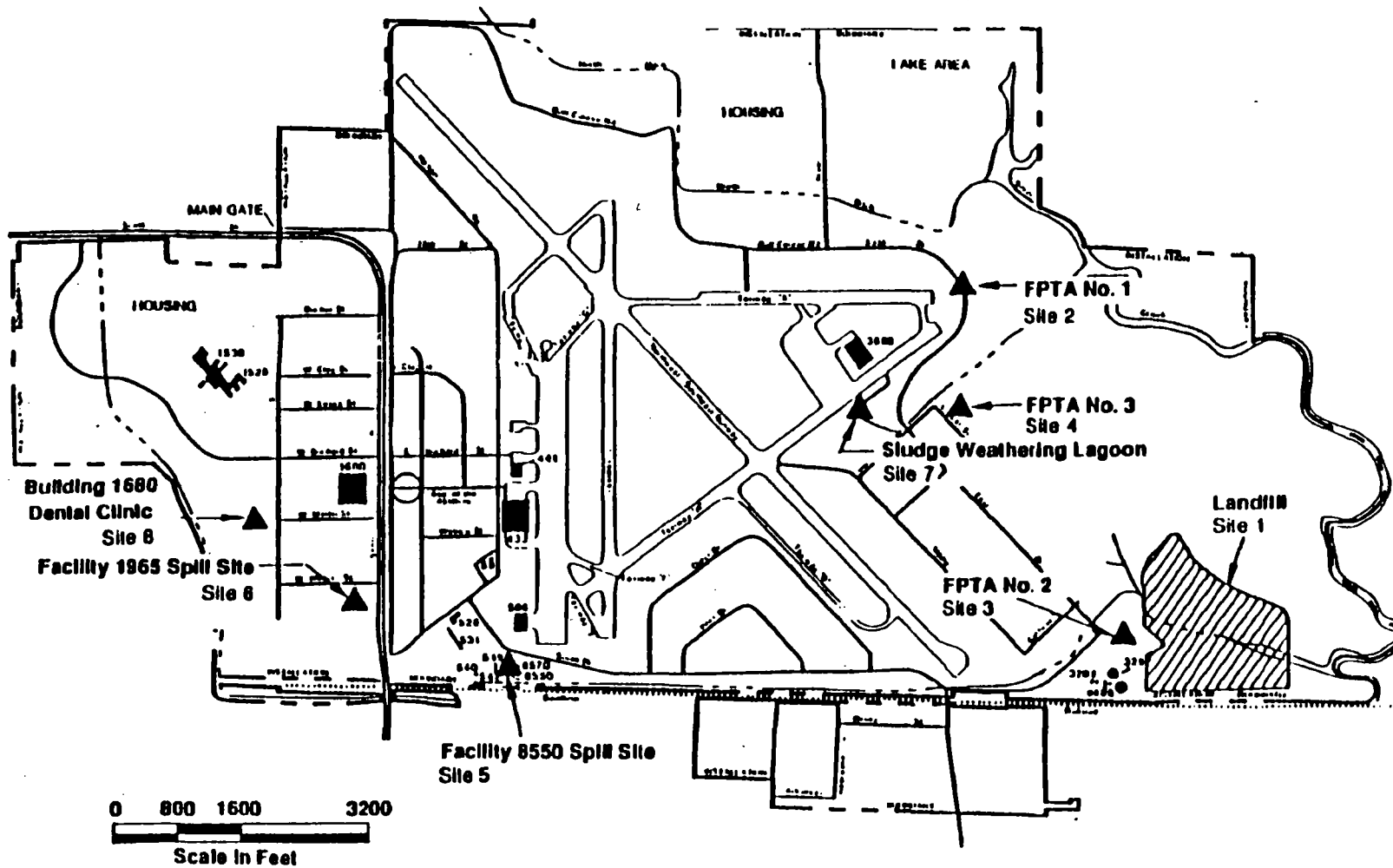
In 1957, Scott AFB became the headquarters installation for the Military Airlift Command (MAC). Several units were transferred to Scott AFB including: Headquarters of the Air Weather Service, Aerospace Rescue and Recovery Service, and the Air Force Communications Service. The 1405th Aeromedical Transport Wing was established at Scott in 1964, and has now expanded to become the 375th Aeromedical Airlift Wing. In 1975, approximately 30 Air Force Reserve and Air National Guard units were assigned to the 375th Aeromedical Airlift Wing to further consolidate airlift functions. Current activities include: worldwide cargo, troop and patient airlift; weather and rescue-recovery services; and western hemisphere telephonic communications.

1.2.1.1 Landfill - The landfill is a 60-acre area located in the southeastern portion of the base (Figure 1-1). The landfill is divided into two cells (the North and South Cell) by Mosquito Creek. The landfill began operations in the early 1940s. Domestic refuse, hardfill and construction rubble, coal ash from base steam generation, sewage treatment plant sludge, and industrial wastes (including paint in cans, pesticides, oils, transformers and drums of unknown contents) were disposed at the landfill. The waste buried in the landfill is approximately 30 to 40 feet deep. An area located in the landfill is designated as an explosive ordnance disposal (EOD) area. The EOD area is thought to contain small caliber ammunition. In 1976 the landfill was closed; however, hardfill and construction rubble and sewage treatment plant sludge have been disposed on the surface since 1983. Debris such as empty drums, pipes and telephone poles are visible over much of the landfill surface. There is some stressed vegetation on the south cell landfill. The water table in the area of the landfill is reportedly shallow and ground water is potentially in contact with wastes.

Volatile organic compounds including vinyl chloride, trans-1,2-dichloroethene, trichloroethene (TCE) and benzene; and arsenic and barium have been identified in ground-water samples. Volatile organic compounds including 1,2-dichloroethene, chlorobenzene and chloromethane; polynuclear aromatic hydrocarbons (PAHs); and a number of inorganic compounds including arsenic, thallium and selenium have been identified in soil samples. Data summaries for each sampling location during the 1988 and 1991 sampling efforts are presented in Law's March 1993 Work Plan (Law, 1993). The data summaries were based on information presented by Environmental Resource Management (ERM) in their April 1992, Stage I RI/FS Technical Report for Scott AFB (ERM, 1992).

1.2.1.2 FPTA No. 1 - The exact location of FPTA No. 1 is unknown, but is believed to be situated to the north and west of the small

FIGURE 1-1  
**IRP STUDY SITES**  
 SCOTT AIR FORCE BASE, ILLINOIS



1-5



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arms range (Figure 1-1). The area was in operation from 1942 to 1953. Fuel (including waste alcohol, gasoline, paint thinners and waste JP-4) was stored in 55-gallon drums adjacent to the site. During exercise operations, which retired base personnel indicate took place about once a month, several hundred gallons of fuel were emptied onto a soil and gravel covered area, ignited and extinguished. A collection system was not used for the recovery of unburned fuel. A softball field is currently located at the site.

Target Compound List (TCL) volatile organics, TCL semi-volatile organics, total recoverable petroleum hydrocarbons (TRPH) and lead were the only parameters analyzed when evaluating both the water and soil matrices. TRPHs were identified in ground-water and soil samples collected at FPTA No. 1. Soil samples also contained elevated levels of lead. Data summaries from previous ERM-sampling efforts at this site are presented in the Work Plan (Law, 1993).

1.2.1.3 FPTA No. 2 - FPTA No. 2 is located just west of the landfill (Figure 1-1). It was operated from 1953 to 1969, for fire training exercises. The fuel (including waste alcohol, gasoline, paint thinners and waste JP-4) was stored in 55-gallon drums. Often there were more than 200 drums stored adjacent to the site. Fire training was practiced one to two times a month. The training involved pouring five to ten drums onto a soil and gravel covered area, igniting the fuel and finally extinguishing it (unburned fuel collection was not used at this site). Extinguishing agents included chlorobromomethane (CB), protein foam, and carbon dioxide.

The TCL volatile organics, TCL semi-volatile organics, TRPH and lead were the only parameters analyzed when evaluating both the water and soil matrices. No contaminants were detected in ground-water samples collected at FPTA No. 2 at concentrations exceeding standards established by the Environmental Protection Agency (EPA) and the World Health Organization (WHO). Xylene, arsenic, barium,

chromium, lead, silver, mercury and selenium were identified in soil samples collected at FPTA No. 2. Data summaries for the previous sampling efforts at this site are presented in the Work Plan (Law, 1993).

1.2.1.4 FPTA No. 3 - FPTA No. 3 is located just south of Monroe Street and east of Locust Street (Figure 1-1). The site was activated in 1969 and was just recently closed. Fire training exercises were conducted two to three times a quarter. During fire training exercises, approximately 900 gallons of JP-4 waste fuel were emptied onto the burn area. Extinguishing agents included Aqueous Film-Forming Foam (AFFF), halon 1211, CB, protein foam, and ABC dry chemical. In 1979, an unburned fuel collection system was installed. The system consists of a concrete-lined burn pit draining into an oil-water separator and an underground fuel storage tank. The oil product from the oil-water separator was stored in the underground tank and was re-used in future training exercises. The water from the separator drained to the base sanitary sewer system.

The TCL volatile organics, TCL semi-volatile organics, TRPH and lead were the only parameters analyzed in both water and soil matrices. Volatile organic compounds including vinyl chloride, TCE and benzene have been identified in ground-water samples. Volatile organic compounds including ethylbenzene, xylene and 1,2-dichlorobenzene; semi-volatile organic compounds including naphthalene and 2-methylnaphthalene; and lead were identified in soil samples. Data summaries for the 1988 and 1991 sampling efforts are presented in the Work Plan (Law, 1993).

1.2.1.5 Facility 8550 Spill Site - Facility 8550 is located on the southern end of the base approximately 1600 feet east of Scott Drive (Figure 1-1). In 1977, a spill incident occurred in which

120,000 gallons of JP-4 was released. Approximately 107,000 gallons were recovered from the diked area surrounding the tank, leaving about 13,000 gallons lost. An undetermined amount of fuel apparently escaped to the south ditch located south of tank 8550. Fuel recovery wells were installed in an attempt to recover the lost fuel; however, the effort was unsuccessful.

Semi-volatile organic compounds and TRPHs were the only parameters analyzed in both water and soil matrices. Volatile organic analysis was included for water matrices. Contaminants were not detected in ground-water samples. 2-methylnaphthalene, various PAHs and TRPHs were identified in soil samples. Data summaries for the 1988 and 1991 sampling efforts are presented in the Work Plan (Law, 1993).

1.2.1.6 Facility 1965 - Facility 1965 is located in the southwest corner of the base (Figure 1-1). In the mid-1970s a fuel leak was discovered from an underground storage tank (UST) located adjacent to Facility 1965 (BX service station). The leak was discovered when petroleum odors were detected in sewer lines located next to the tank; it is not known how long the tank may have been leaking. An undetermined amount of motor vehicle gas (MOGAS) was released, with minimal recovery during tank repairs.

Semi-volatile organic compounds, TRPH and lead were the only parameters analyzed for both water and soil matrices. Volatile organic analysis was included for water matrices. High levels of benzene were detected in ground-water samples. Semi-volatile organic compounds including 2-methylnaphthalene and di-n-butylphthalate; TRPHs; and lead were identified in soil samples. Data summaries for the 1988 and 1991 sampling efforts are presented in the Work Plan (Law, 1993).

1.2.1.7 Sludge Weathering Lagoon - The sludge weathering lagoon is located east of tanks 8552 and 8554 (Figure 1-1). The lagoon was approximately 20 feet wide and 40 feet long and was used during the mid-1970s for the disposal of tank bottom sludge. Industrial waste liquids were also reportedly disposed in the lagoon, including scrap paint, paint thinners and waste oils. In 1981 two feet of soil were excavated from the lagoon and transported off base. The site was backfilled with sand and gravel.

Ground-water samples collected were analyzed for volatile organic compounds, semi-volatile organic compounds, pesticides/polychlorinated biphenyls (PCBs), TRPHs, herbicides and target analyte list (TAL) inorganics. Soil samples collected were analyzed for volatile organic compounds, semi-volatile organic compounds, TRPHs and metals. Contaminants were not detected in ground-water samples. Benzene, toluene, xylene and ethylbenzene (BTEX); phenanthrene; and arsenic, selenium, thallium and mercury were identified in soil samples collected. Data summaries for the 1988 and 1991 sampling efforts are presented in the Work Plan (Law, 1993).

1.2.1.8 Building 1680 - Building 1680 is the old dental clinic which operated from the late 1940s to 1984 (Figure 1-1). It is currently used as a satellite pharmacy, office building and optometry clinic. Dental amalgams containing mercury and possibly silver were routinely disposed in the sink. During the Stage 1 RI, mercury contamination was identified from soil samples collected from the crawl space under the building; the crawl space is utilized for utility maintenance activities. Mercury was the only parameter analyzed and soil was the only matrix collected.

### 1.2.2 Project Objectives

The following sections describe the site specific scope and objectives. The objectives described below will be accomplished through the collection of geological data, hydrological data and environmental samples; the laboratory analysis of these samples for potential contaminants; the evaluation of the analytical results and field measurements with respect to quality control data; and the interpretation and analysis of valid data.

1.2.2.1 Landfill - The RI for the landfill at Scott AFB, is designed to determine ground-water flow direction; to determine if ground water from the landfill is discharging into Mosquito Creek; and to delineate the vertical and horizontal extent of contamination. The data collected will be used to characterize environmental conditions and quantitatively estimated the risk to human health and to the environment.

To determine the spatial extent of the contamination, 17 monitoring wells will be installed, including 12 shallow wells and five deep wells. The five deep wells will be clustered with five shallow wells so that multiple ground-water zones located within the aquifer will be vertically represented.

The 17 new monitoring wells and six of the existing monitoring wells at the landfill will be sampled to monitor trends in the contaminant levels downgradient from the site.

Subsurface soil samples will be collected from the ten monitoring well borings (soil samples will be collected from the deep well borings only when well clusters are installed) to determine the nature and extent of the subsurface soil contamination.



Twenty surface soil samples will be collected from the landfill, including ten from the north cell and ten from the south cell. These results will be used to determine the nature and extent of surface soil contamination and to assess the potential risk through dermal exposure.

Five surface water and sediment samples will be collected from Mosquito Creek. Surface water and sediment samples will be collected from upgradient of the site, from the Waste Water Treatment Plant (WWTP) discharge point, from just downgradient of the WWTP discharge point, from the tributary that borders the south landfill cell to the east, and from just downgradient of this tributary.

A soil gas survey will be conducted at the Landfill to aid in the delineation of the likely extent of the contaminant plume. The soil gas results will be used as input to an atmospheric transport and dispersion model which will provide a preliminary evaluation of the volatile emissions exposure pathway.

To improve the understanding of hydrological conditions at the landfill (potentiometric surface, ground-water flow direction, hydraulic gradient) the following procedures will be performed:

1. Conduct twice daily water level measurements in five existing wells over a three month period, using a Well Sentinel single channel data logger.
2. Conduct a complete round of water level measurements in all existing wells at the beginning and during the field sampling effort.
3. Conduct a pumping test.

4. Monitor stream flow volumes at three locations on Mosquito Creek.

1.2.2.2 Fire Protection Training Area No. 1 - The RI for the FPTA No. 1 at Scott AFB, is designed to delineate the horizontal extent of contamination. The data collected will be used to characterize environmental conditions and quantitatively estimate the risk to human health and to the environment.

Five surface soil samples will be collected at FPTA No. 1. Results will be used to assess potential risk from exposure to soils at the softball field which is now located on the site. The five sample locations were determined based on high soil gas measurements documented in the previous RI study (ERM, 1992).

1.2.2.3 Fire Protection Training Area No. 2 - The RI for the FPTA No. 2 at Scott AFB, is designed to delineate the vertical and horizontal extent of contamination. The data collected will be used to characterize environmental conditions and quantitatively estimate the risk to human health and to the environment.

Two shallow monitoring wells will be installed to further define the nature and extent of contamination in the ground water. The new wells and two of the existing wells (MW3-2 and MW3-3) will be sampled to monitor trends in the contaminant levels downgradient from the site.

Subsurface soil samples will be collected from the monitoring well borings and two additional soil borings to determine the nature and extent of the subsurface soil contamination. The additional soil boring locations were determined based on high soil gas measurements documented in the previous RI study (ERM, 1992).

Five surface soil samples will be collected to determine the levels of metals contamination in the surface soils.

1.2.2.4 Fire Protection Training Area No. 3 - The RI for the FPTA No. 3 at Scott AFB, is designed to delineate the vertical and horizontal extent of contamination. The data collected will be used to characterize environmental conditions and quantitatively estimate the risk to human health and to the environment. In addition, an Immediate Response Action (IRA) to remove the oil-water collection system and excavate contaminated soils may be implemented by the base.

Hydropunch will be used to collect ground-water samples from thirty locations. The samples will be analyzed in an on-site mobile lab by field gas chromatograph (GC). Two shallow monitoring wells will be positioned based on the hydropunch/field GC results. The hydropunch/field GC results will also be used to delineate the extent of the contaminant plume. The monitoring well results will be used to confirm nature and extent of ground-water contamination.

A monitoring well cluster, consisting of one deep and one shallow well, will be installed downgradient of the burn pit, adjacent to existing well MW4-2. The deep well will be used to monitor dense non-aqueous phase liquids (DNAPLs) and the shallow well will be used to monitor light non-aqueous phase liquids (LNAPLs). The shallow wells installed by EMR were screened below the water table and thus would not indicate the presence of any LNAPLs on top of the water table. This well (MW4-2) contained elevated concentrations of volatile organic compounds including tetrachloroethene and vinyl chloride. Ground water will be sampled from all new wells and existing monitoring wells MW4-1 and MW4-2. The results will be used to estimate the extent of ground-water contamination.

Soil samples will be collected from the four monitoring well borings. Four additional soil borings will be installed, three located around the burn pit and one located adjacent to the UST. The results will be used to estimate the nature and extent of subsurface soil contamination.

To further define the hydrological conditions at the site, an aquifer (slug/bail) test will be conducted.

1.2.2.5 Facility 8550 - The RI for Facility 8550 at Scott AFB, is designed to delineate the vertical and horizontal extent of contamination and to determine the existence of floating product. The data collected will be used to characterize environmental conditions and quantitatively estimate the risk to human health and to the environment.

Hydropunch will be used to collect ground-water samples from thirty locations. The samples will be analyzed in an on-site mobile lab by field GC. Two shallow monitoring wells will be installed based on the hydropunch/field GC results. The hydropunch/field GC results will also be used to delineate the extent of the contaminant plume. The monitoring well results will be used to estimate nature and extent of ground-water contamination.

One additional well will be installed upgradient of the site for background information.

Soil samples will be collected from each of the monitoring well borings to determine the nature and extent of subsurface soil contamination.

Five surface water and sediment samples will be collected from the south ditch, adjacent to the base boundary, to help delineate the contaminant plume.

Ten surface soil samples will be collected in the area located between the site and the south ditch. These results will be used to determine the magnitude and extent of surface soil contamination and to assess the potential risk through dermal exposure.

1.2.2.6 Facility 1965 - The RI for Facility 1965 (BX Gas Station) at Scott AFB is designed to determine the nature and extent of gasoline contamination and to determine the existence of floating product. The FS portion of this investigation likely will include a treatability study to evaluate soil and ground-water remediation alternatives. The detection of benzene in ground water at levels greater than 7000 ppb during the previous investigative studies suggests that the site will likely require soil and ground-water remediation.

Field screening will consist of drilling twenty soil borings to facilitate the use of the Hydropunch. Two soil samples and one ground-water sample will be obtained from each boring and analyzed by field GC.

The second phase of activities scheduled for the BX Gas Station includes the installation and sampling of four monitoring wells and one recovery well. Existing monitoring well MW6-2 will also be resampled. Locations for new wells will be determined from hydropunch/field GC results. Soil and ground-water samples will be collected from the borings to determine the nature and extent of contamination. In addition, the extraction well will provide a pumping well for an extraction test and for a soil gas vapor extraction test, to further define hydrological conditions and evaluate remedial alternatives. In addition, the four monitoring wells will provide observation points for the aquifer tests. The final phase of investigative activities will include tests to evaluate different remediation alternatives. An eight-hour step drawdown test will be performed to determine the maximum

sustainable pumping rate for the pumping test. A 24-hour pumping test will be conducted to determine the hydrological conditions at the site and to evaluate the suitability of pump and treat as a remedial alternative. A recovery test will be performed to assist in evaluating the hydraulic conductivity of the aquifer. Finally, a vapor extraction test will be performed to further define hydrological conditions and to evaluate soil vapor extraction as an option for in-situ soil remediation.

Results obtained from the three phases described above will help determine the data needs of a treatability study.

1.2.2.7 Sludge Weathering Lagoon - The RI for the Sludge Weathering Lagoon is designed to delineate the vertical and horizontal extent of contamination. The data collected will be used to characterize environmental conditions and quantitatively estimate the risk to human health and to the environment.

Hydropunch will be used to collect ground-water samples from eighteen locations. The samples will be analyzed in an on-site mobile lab by field GC. These results will be used to delineate the extent of the contaminant plume. Two additional hydropunch samples will be collected at locations exhibiting high field GC results. These samples, along with QA/QC samples, will be sent to the certified laboratory for analyses.

Three surface water and sediment samples will be collected from the ditch that borders the site to the southeast. An additional surface water and sediment sample will be collected at the ditch's discharge point into Silver Creek.

1.2.2.8 Building 1680 - An Immediate Response Action will be implemented at Building 1680 to eliminate potential surface soil

exposures in the crawl space. Concrete will be poured onto the soil beneath the crawl space, if accessible; otherwise, the soil will be covered with plastic sheeting.

The Scott AFB BioEnvironmental Engineers collected and analyzed ambient air samples from the crawl space under the building. These results, along with the QA/QC results, will be evaluated by Law to determine their validity. Valid data will eliminate the volatile emissions of mercury as an exposure pathway of concern since positive results were not detected. If the data are found to be invalid, the ambient air from the crawl space will be re-sampled at a time when seasonal temperatures are at a high in order to represent the "worst-case" for volatile emissions.

#### 1.2.3 Project Data Objectives

The data generated by this project must be of sufficient quality and quantity to meet the overall project objective, which is to determine the nature and extent of contamination associated with the eight sites at Scott AFB. Data for this RI/FS are required for the following use categories:

- Site Characterization - Data will be used to determine the nature and extent of contamination. Characterization of this site will use data generated by the collection and analysis of soil, ground-water, surface water and sediment samples.
- Health and Safety - Data will be used to establish the level of protection needed for the work party and other site related personnel. This data will be gathered by the use of organic vapor analyzers (HNu), Draeger tubes, real-time aerosol monitors and explosimeters during intrusive activities.

- Risk Assessment - The data will be used to evaluate the threat to public health and the environment.
- Evaluation of Alternatives - Data collected from the various matrices will be used to evaluate remedial alternatives.

The data collected for these use categories will be accomplished by meeting and executing data quality objectives. The primary data quality objectives (DQOs) for the field work will be accomplished by the activities to be performed. Activities to be performed during the Field Sampling Program include the following:

- Soil gas survey
- Hydropunch survey
- Soil boring and sampling
- Monitoring well installation and ground-water sampling
- Surface water and sediment sampling
- Aquifer testing

#### ANALYTICAL LEVELS

Data generated by the RI/FS field activities are categorized by data quality. Data quality is measured by analytical technique or levels. These analytical levels are presented below as defined in EPA's Data Quality Objectives for Remedial Response Activities, 540/G-87 003, March 1987.

- Level I - field screening or analysis using portable instruments. Results are often not compound specific and not quantitative, but results are available in real-time. It is the least costly of the analytical options.
- Level II - field analyses using more sophisticated portable analytical instruments: in some cases, the



instruments may be set up in a mobile laboratory on site. There is a wide range in the quality of data that can be generated. It depends on the use of suitable calibration standards, reference materials and sample preparation equipment; and the training of the operator. Results are available in real-time or several hours.

Level III - all analyses performed in an off-site analytical laboratory. Level III analyses may or may not use CLP procedures, but do not usually utilize the validation or documentation procedures required of CLP level IV analysis. The laboratory may or may not be a CLP laboratory.

The data generated by the field equipment such as the magnetometer, HNu, explosimeter, electronic interface probe, water level indicators, pH meters, specific conductance meters and turbidity meters will consist of Analytical Level I. Analytical Level I provides results in real time and can be used to identify the presence of contamination.

The data generated by the soil gas survey will be Analytical Level II. Analytical Level II data are controlled by limited quality control and instrumentation.

*field QC of 51W-3  
DQOs.*

The data generated by the laboratory analysis of soil, groundwater, surface water and sediment samples must be sufficient to allow comparison of the results to the Applicable or Relevant and Appropriate Requirements (ARAR), such as Maximum Contaminant Levels and Ambient Water Quality Criteria. These data will be Analytical Level III. Analytical Level III incorporates the use of EPA methods with detection limits below ARARs allowing for sufficient qualitative and quantitative results. Documentation requirements and the rigorous QA/QC program associated with Analytical Level III provide support for legally and scientifically defensible data. Table 1-1 summarizes the data uses as related to Analytical Level.

TABLE 1-1

**SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES**  
**Scott Air Force Base, Illinois**

DATA USES	ANALYTICAL LEVEL	TYPE OF ANALYSIS	DATA QUALITY	FIELD ACTIVITIES
<ul style="list-style-type: none"> <li>- Site characterization</li> <li>- Monitoring during implementation</li> </ul>	Level I	<ul style="list-style-type: none"> <li>- Total organic/inorganic vapor detection using portable instruments</li> <li>- Field test kits</li> </ul>	<ul style="list-style-type: none"> <li>- If instruments calibrated and data interpreted correctly, can provide indication of contamination</li> </ul>	<ul style="list-style-type: none"> <li>- HNU</li> <li>- Explosimeter</li> <li>- Draeger tubes</li> <li>- pH</li> <li>- Specific conductance</li> <li>- Temperature</li> <li>- Turbidity</li> <li>- Water level</li> <li>- Geophysical survey</li> </ul>
<ul style="list-style-type: none"> <li>- Site characterization</li> <li>- Evaluation of alternatives</li> <li>- Engineering design</li> <li>- Monitoring during implementation</li> </ul>	Level II	<ul style="list-style-type: none"> <li>- Variety of organics by GC; inorganics by AA; XRF</li> <li>- Tentative ID; analyte-specific</li> <li>- Detection limits vary from low ppm to low ppb</li> </ul>	<ul style="list-style-type: none"> <li>- Dependent on QA/QC steps employed</li> <li>- Data typically reported in concentration ranges</li> </ul>	<ul style="list-style-type: none"> <li>- Soil gas survey</li> <li>- Hydropunch</li> </ul> <p><i>See plan further.</i></p>
<ul style="list-style-type: none"> <li>- Risk assessment</li> <li>- PRP determination</li> <li>- Site characterization</li> <li>- Evaluation of alternatives</li> <li>- Engineering design</li> <li>- Monitoring during implementation</li> </ul>	Level III	<ul style="list-style-type: none"> <li>- Organics/inorganics using EPA procedures other than CLP can be analyte-specific</li> <li>- RCRA characterization tests</li> </ul>	<ul style="list-style-type: none"> <li>- Similar detection limits to CLP</li> <li>- Less rigorous QA/QC</li> </ul>	<ul style="list-style-type: none"> <li>- Ground-water samples</li> <li>- Soil samples</li> <li>- Surface water samples</li> <li>- Sediment samples</li> </ul>

NA - Not applicable to these sites.

Source - Law Data Management Plan

#### 1.2.4 Subcontractors

Subcontractors will be identified prior to field activities to perform soil gas surveys, topographic surveys, hydropunch, and field GC operations.

### 1.3 PROJECT ORGANIZATION AND RESPONSIBILITIES

Project organization and responsibilities for the RI/FS at Scott AFB are discussed in the following sections.

#### 1.3.1 Project Organization

Law Environmental, Inc., Government Services Division (Law) will manage the project and provide services related to field samples, data analysis, site characterization, and reporting.

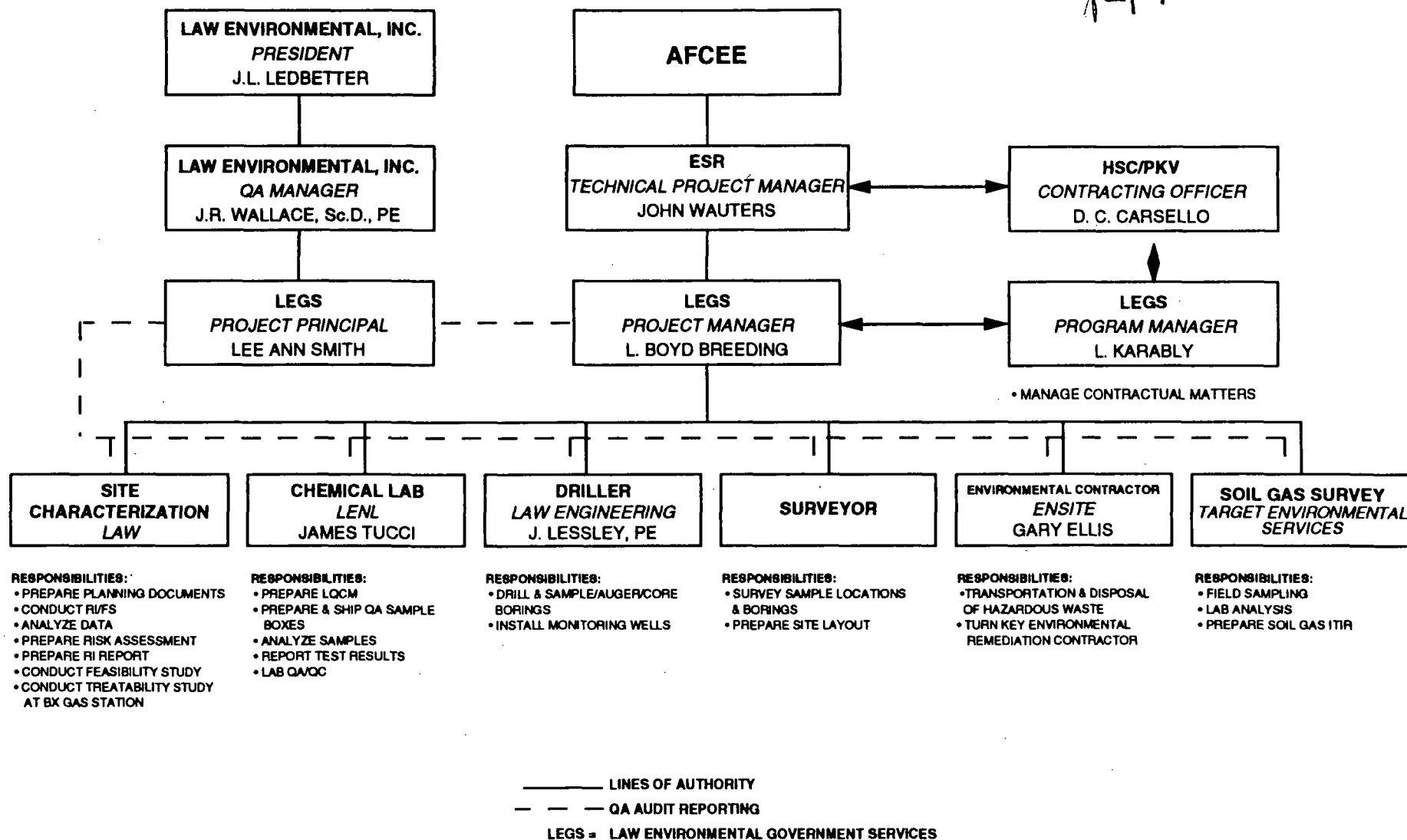
Law Engineering Drilling Services will be subcontracted to perform the drilling activities. (Law Environmental National Laboratories (LENL) will be subcontracted to perform the chemical analysis of the soil and water samples. An Occupational Safety and Health Administration (OSHA) certified and state licensed local surveying company will be subcontracted to survey the soil borings, sampling locations and prepare a site map. Ensite will be subcontracted to handle transport and disposal of drummed soil cuttings and purge water generated during investigative activities. Additional subcontractors will be identified to perform the hydropunch, (soil gas survey), and topographic survey and to operate the field GC. The project organization is shown on Figure 1-2.

*response analysis*

1.3.1.1 Law Environmental, Inc. - Law Environmental's Government Services Division will provide the project management, engineering and analysis, and sampling through its in-house resources. It is

FIGURE 1-2  
**PROJECT ORGANIZATION AND QM RESPONSIBILITIES**  
 REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
 SCOTT AFB, ILLINOIS

*QAM.  
RPM.*



a branch of Law Environmental, Inc., which in turn is a wholly owned subsidiary of Law Companies Group, Inc. Law Companies Group, Inc. is entirely employee owned.

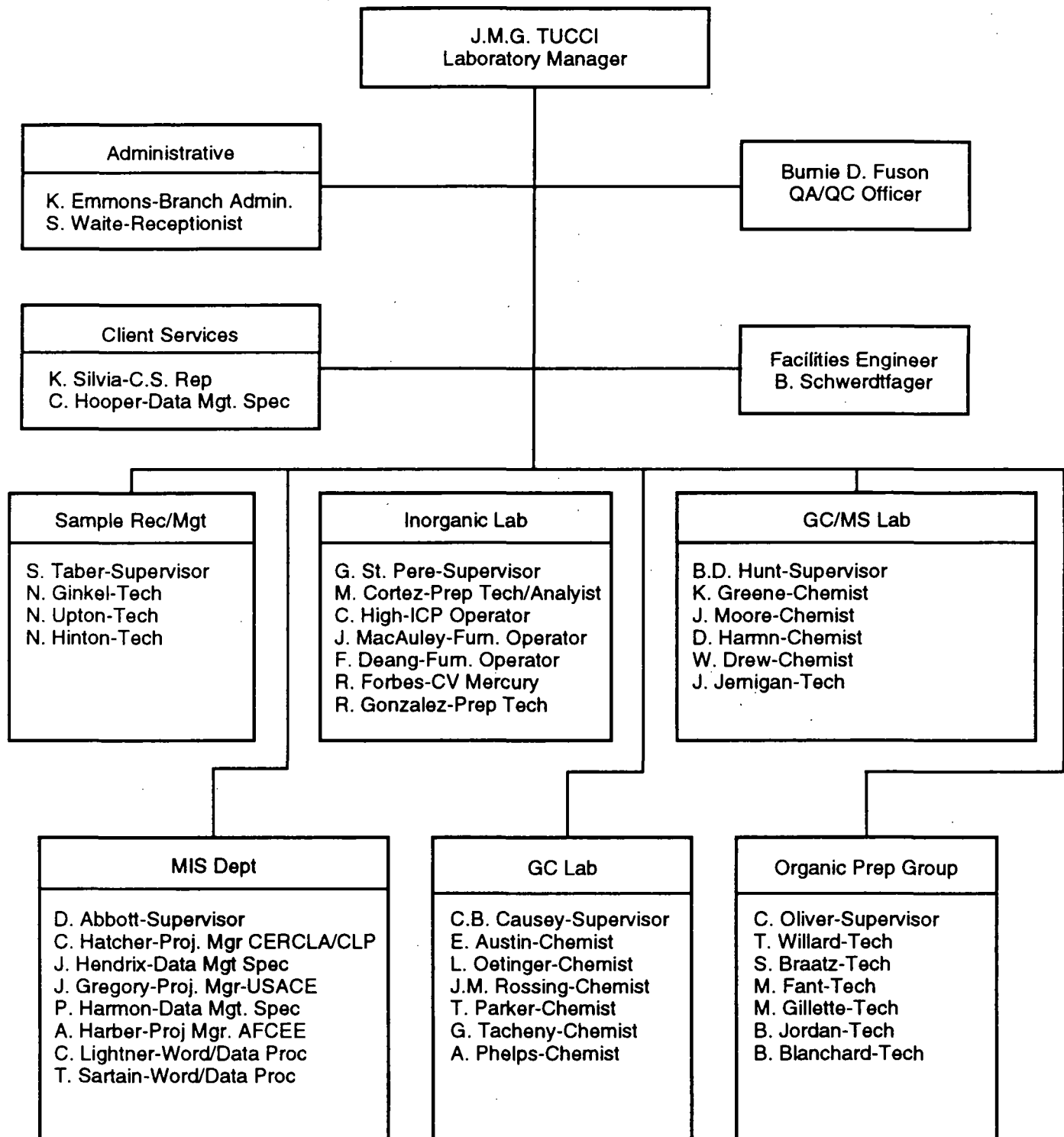
1.3.1.2 Drilling Subcontractor - Law Engineering Drilling Services will be responsible for the drilling and installation of monitoring wells. The drilling engineer will follow direction from the Site Manager during field activities and from the Project Manager prior to and after field work.

*address*

1.3.1.3 Law Environmental National Laboratories (LENL) - LENL-Pensacola, is the Law Environmental, Inc. chemical testing laboratory, which was established in 1989. LENL will be responsible for providing sample shipping containers, chain-of-custody documents, chemical analysis and reporting, and laboratory QA/QC. LENL will report directly to the Project Manager during all phases of the project. LENL - Pensacola has integrated Quality Assurance Control (QA/QC) procedures into their laboratory design and standard operating procedures. LENL is certified in several states. In order to perform analyses for AFCEE projects, LENL has undergone and complied fully with MITRE Corporation audits. LENL's key personnel and their positions and responsibilities are outlined in Figure 1-3 and Table 1-2.

1.3.1.4 Surveying Subcontractor - A local engineering and surveying firm will be subcontracted to survey boring/sampling locations and elevations and prepare the site maps. The firm will report directly to the Site Manager during their survey activities and to the Project Manager prior to and after field work.

FIGURE 1-3  
**LAW ENVIRONMENTAL, INC.**  
**NATIONAL LABORATORIES DIVISION**  
**PENSACOLA ORGANIZATION CHART**



**TABLE 1-2**  
**LENL KEY PERSONNEL AND RESPONSIBILITIES**

<u>Position/Key Personnel</u>	<u>Responsibilities</u>
Laboratory Manager James M. G. Tucci	<ul style="list-style-type: none"> <li>- Implement methodologies and procedures consistent with the generation of legally defensible data;</li> <li>- Provide overall management and operation of the lab;</li> <li>- Provide a safe working environment for employees;</li> <li>- Provide resolutions to items requiring corrective actions;</li> <li>- Provide training programs for employees;</li> <li>- Interact with QA/QC Coordinator to resolve analytical, methodological and QA/QC problems;</li> <li>- Obtain laboratory accreditations;</li> <li>- Schedule work in a manner consistent with personnel and instrumentation;</li> <li>- Implement procedures consistent with and building upon our philosophy of honesty, trust and ethics; and</li> <li>- Implement actions required to establish our lab as a premier laboratory.</li> </ul>

TABLE 1-2

## LENL KEY PERSONNEL AND RESPONSIBILITIES

<u>Position/Key Personnel</u>	<u>Responsibilities</u>
QA/QC Coordinator Burnie D. Fuson	<ul style="list-style-type: none"> <li>- Implement the branch QA program;</li> <li>- Develop the QA/QC manual;</li> <li>- Establish and maintain safety standards and operating procedures;</li> <li>- Coordinate and audit the technical review of deliverables;</li> <li>- Issue recommendations and corrective actions required for any aspect of laboratory operations inconsistent with established policies and procedures;</li> <li>- Monitor and identify out-of-control or potentially out-of-control situations to Operations Manager, Supervisors, and Branch Manager;</li> <li>- Provide guidance for the chemistry QA/QC program development;</li> <li>- Interact with external QA personnel concerning the lab's certifications and QA policies/procedures and coordinating QA compliance as required;</li> <li>- Keep abreast of new techniques and programs for QA and safety and inform Branch Manager and Operations Manager;</li> <li>- Coordinate the development of project QA plans as required;</li> <li>- Provide historical QA reports for each method to the Branch Manager; and</li> <li>- Perform QA/QC audits, provide blind check samples and monitor results.</li> </ul>



**TABLE 1-2**  
**LENL KEY PERSONNEL AND RESPONSIBILITIES**

<u>Position/Key Personnel</u>	<u>Responsibilities</u>
Management Information Systems Department Damon Abbott	<ul style="list-style-type: none"> <li>- Establish and maintain the computer systems, the network, and the LIMS (Laboratory Information Management System);</li> <li>- Provide data deliverables in U.S. EPA CLP format with hard copy and disc deliverable formats;</li> <li>- Develop software necessary to meet other client's deliverable formats;</li> <li>- Interpret U.S. EPA CLP Statements of Work - Organics and Inorganics for requirements and deliverables;</li> <li>- Interface analytical instruments' data systems with our IBM Token Ring Network and develop software required at the interface;</li> <li>- Train department personnel in various data entry software packages purchased or developed internally;</li> <li>- Provide guidance and direction to other departments where required or requested or as determined by Branch Manager;</li> <li>- Provide support to QA/QC Coordinator where necessary to automate, archive and generate QC trends from historical records; and</li> <li>- Provide support and guidance for entire laboratory operation, from sample receiving through the generation of data deliverable packages, to streamline and increase productivity through computer automation.</li> </ul>

**TABLE 1-2**  
**LENL KEY PERSONNEL AND RESPONSIBILITIES**

<u>Position/Key Personnel</u>	<u>Responsibilities</u>
Lab Supervision C. Oliver (Organics) B. D. Hunt (GC/MS) Carl Causey (GC) Gary St Pere (Inorganics)	<ul style="list-style-type: none"> <li>- Provide overall supervision of department/section operations;</li> <li>- Implement procedures consistent with the generation of legally defensible data;</li> <li>- Provide QC activities consistent with the branch QC procedures;</li> <li>- Provide additional QC activities, as needed, which are consistent with the Branch QA philosophies;</li> <li>- Provide final report review before releasing;</li> <li>- Provide work assignments to departmental personnel;</li> <li>- Provide analytical job training and cross-training within the department and between departments where applicable and warranted;</li> <li>- Provide corrective action for deficiencies;</li> <li>- Provide quarterly instrument detection limit (IDL) studies;</li> <li>- Maintain maintenance logs on all instruments;</li> <li>- Maintain all standards logs;</li> <li>- Provide leadership and management philosophies consistent with those of the Branch; and</li> <li>- Provide legally defensible data from each department.</li> </ul>

**TABLE 1-2****LENL KEY PERSONNEL AND RESPONSIBILITIES**

<u>Position/Key Personnel</u>	<u>Responsibilities</u>
Sample Receiving and Shipment Sharon Taber	<ul style="list-style-type: none"><li>- Provide sample control via entry of all parameters to be analyzed per sample in LIMS when sample arrives;</li><li>- Provide chain-of-custody receipt of samples externally, and internal from our walk-in cooler to analysts and prep;</li><li>- Provide sample analysis report daily for all samples in-house;</li><li>- Provide prepared sample bottles in refrigerated shippers;</li><li>- Provide for sample disposal/return to sender; and</li><li>- Keep track of supplies, order when needed, bill clients for those used.</li></ul>

### 1.3.2 Key Project Individuals

Key project participants for this project include the project principal, project manager, project chemist, project geologist/site manager, health and safety officer, laboratory manager, and field work parties. The following paragraphs provide a description of the proposed project assignments and responsibilities, a list of individuals expected to serve in each capacity, and a brief synopsis of the participants' related experience.

1.3.2.1 Project Principal - The Project Principal provides quality assurance oversight and direction for all aspects of the site investigation and data evaluation. Ms. Lee Ann Smith will serve as the Project Principal. Ms. Smith is a Registered Hazardous Substance Professional (RHSP) for Law with more than 12 years of experience in project management and site investigations. She will serve as the senior reviewer for all aspects of the project.

1.3.2.2 Project Manager - The Project Manager is responsible for overall management of the Scott AFB Remedial Investigation (RI). He coordinates between office and field personnel, manages administrative requirements, and supervises schedules, technical approach, implementation, and report preparation. Mr. L. Boyd Breeding will serve as project manager.

Mr. Breeding has degrees in Geology and Engineering, nine years of professional experience, and is registered as an Engineer in Training in the state of Missouri. He is presently managing IRP projects at Arnold AFB, Scott AFB, and Ft. Jackson.

1.3.2.3 Project Chemist - The Project Chemist is responsible for preparing and implementing the field sampling, preservation, chain-of-custody, and shipping activities. She performs data evaluation

on all chemical data. Ms. Jill Siegrist will serve as the Project Chemist for this investigation. Ms. Siegrist is a chemist with approximately four years of experience in QA/QC, data evaluation and environmental assessments.

1.3.2.4 Project Geologist/Site Manager - The Project Geologist will be responsible for planning and directing the exploratory geological investigation, and for evaluating the quality of the geological data. The Site Manager will coordinate and supervise all field investigation activities. The Site Manager will also serve as the Health and Safety Officer for the field operations, and will therefore be responsible for the implementation of the Health and Safety Plan. The Site Manager's primary responsibility is the health and safety of the workers. During periods when multiple tasks are being implemented simultaneously, the Law project manager will be on site to coordinate activities and assume Health and Safety responsibilities. Mr. Scott Woods will serve both as the Project Geologist and as the Site Manager for this project. Mr. Woods is a Project Geologist with LEGS, specializing in environmental site investigation and assessment. He has approximately three years of experience in environmental and geotechnical site investigations.

1.3.2.5 Laboratory Project Manager - The Laboratory Project Manager is responsible for the handling and analysis of water and/or soil samples received by the laboratory. This person oversees sample travel through the lab, analytical procedures, quality control, reporting and sample disposal. Mr. James Tucci is LENL's Chemical Laboratory Manager.

1.3.2.6 Work Party - The work party performs on-site tasks contained in this plan, including surveying, monitoring well

installation and analytical sampling under the direction of the Site Manager. The work parties include drilling crews, the surveying team and the sampling team.

1.3.2.7 Health and Safety Officer - The Health and Safety Officer oversees the Health and Safety Plan for Scott AFB. He conducts personnel training, administers company hazard assessment and surveillance medical program, and coordinates with the Site Manager for site safety. He is available for consultation during the actual investigation. Dr. Jack Peng is Law Environmental's Environmental Health and Safety Officer. He is a Certified Industrial Hygienist with over 10 years experience in hazardous waste site investigations. Subcontractors working on the Scott AFB site under this project will receive a copy of the project Health and Safety Plan. Law's Site Manager will review with subcontractor personnel the Health and Safety Plan prior to any field activities.

#### 1.3.3 Project QA Responsibilities

Law Environmental, Inc. has established a strong internal QA program with an associated QA Manual, Engineering Procedures Manual, Equipment Calibration Procedures Manual, and specialty manuals for hazardous waste site investigations and software documentation. Law Environmental employees use these manuals as the basis for conducting all company work within the QA program.

Mr. Leonard Ledbetter, the President of Law Environmental, Inc., has overall responsibility for Law's Corporate QA program. The Corporate QA Office is managed by Dr. James R. Wallace, who is responsible for daily management and auditing of Law Environmental's QA Program. The Law Environmental lines of QA responsibility and audit flow from Corporate QA (Mr. Ledbetter and

Dr. Wallace) to the Project Principal (Ms. Lee Ann Smith). This line of QA is outside of the operational lines of authority for this project.

Our QA Program is one of the most important factors contributing to client satisfaction and our continued success. The purpose of the program is to provide the client with confidence that services are performed correctly.

Our Principal Review System is an integral part of the QA Program. Each project is assigned to a Principal Reviewer who is responsible for maintaining the required professional quality from beginning to completion of the project. Every proposal and report must be reviewed and signed by two people and at least one must be a Law Principal with credentials and experience relevant to the area of work.

In each office, the Chief Scientist or Engineer is responsible for operation of the QA Program and for reviewing the performance of assigned Principals. The Chief Engineer conducts internal audits of projects and at least once each year a formal corporate audit is conducted by Chief Engineers and Principals from other offices. In addition to these internal and corporate audits, the company participates in laboratory and peer review programs sponsored by organizations such as the National Bureau of Standards, US Geological Survey, USEPA, and the U.S. Army Corps of Engineers.

Law Companies encourages staff membership and participation in various relevant professional societies. We believe such involvement fosters individual professional growth and helps keep our staff up-to-date on current developments. Many Law Principals also serve on subcommittees or teach in sponsored workshops.

Law will control the quality of subcontractor furnished data and services by source evaluation and selection, evaluation of

objective evidence of quality compliance to procurement documents furnished by the subcontractor, site and/or source inspections, audits, and/or examination of items or services upon delivery or completion. Prior to award of subcontract, potential suppliers of quality affecting items or services will be evaluated by Law personnel. The evaluation may be performed by any appropriate means, including but not limited to surveys, inspections, audits, or surveillances, depending upon the complexity of the item or service being supplied. When the Project Principal determines it necessary, on-site audits of subcontractor facilities may be conducted under the QA program. While the responsibility for quality remains with the subcontractor under his QC program, Law will conduct certain QC activities to determine the subcontractor's compliance with his own quality program.

#### 1.4 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Quality Assurance (QA) objectives for measurement data are expressed in terms of accuracy, precision, completeness, representativeness, and comparability. QA objectives provide the mechanism for ongoing control and evaluation of measurement data quality throughout the project and will ultimately be used to define data quality for the various measurement parameters. These QA/QC objectives will be accomplished through the collection of field duplicates, rinsates, trip blanks and field blanks. The analytical QA/QC will be assessed by the internal QC such as method blanks, surrogate recoveries, adherence to holding times and matrix spike and matrix spike duplicate data.

##### 1.4.1 QA Criteria

The following sections list and define the QA criteria applicable to Scott AFB.



1.4.1.1. Accuracy - Accuracy refers to the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. Analytical accuracy may be expressed as the percent recovery of an analyte which has been added to the environmental sample at a known concentration before analysis. For example, accuracy can be determined from the results of matrix spike analyses performed at the rate of one set every 20 samples or one per batch. The equation used to calculate percent recovery can be found in Section 1.13.1.

The accuracy of simple, yet fundamental, field analyses is difficult to assess quantitatively. Sampling accuracy can be maximized, however, by the adoption and adherence to a strict QA program. Specifically, all procedures will be documented as standard protocol and all equipment and instrumentation will be properly calibrated and well maintained. Trip blanks (analyzed for volatile organics only) and equipment rinsates (analyzed for all parameters) will be included in all sample batches to ensure all samples represent the particular site from which they were taken and to assess the potential for any cross-contamination that may have occurred. In addition to equipment operation and standard operating procedures, a high level of accuracy will be maintained by thorough and frequent review of field procedures. In this manner, any deficiencies will be quickly documented and corrected.

1.4.1.2 Precision - Precision refers to the reproducibility or degree of agreement among duplicate measurements of a single analyte. The closer the numerical values of the measurements are to each other, the more precise the measurement. The primary role of this application is to characterize the precision of any analytical method under specified conditions. This allows immediate comparison of precision of different results produced by

the same method. Analytical precision for a single analyte is expressed as a percentage of the difference between results of duplicate samples and matrix spike duplicates for a given analyte. Relative percent difference is calculated as shown in Section 1.13.1.

Precision will be determined through the collection of field duplicates and matrix spikes and matrix spike duplicates for the analytical work performed at Scott AFB. The sampling chemist will select 1 sample in 20 (or 1 per batch, whichever has the fewer number of samples) for that matrix and split the sample into three aliquots. The first aliquot will be analyzed routinely for the parameters of interest, while the other two aliquots will be spiked with known quantities of the parameters of interest prior to analysis. The relative percent difference (RPD) will be calculated and used as an indication of the precision for the analyses performed.

During the collection of data using field methods and/or instrumentation, precision is checked by reporting several measurements taken at one location and comparing the results. Precision will be reported as the RPD for two results and as the standard deviation for three or more results. Sample collection precision will be measured in the laboratory with the analysis of field replicates and laboratory duplicates.

1.4.1.3 Completeness - Completeness is expressed as the percentage of valid data obtained from a measurement system. For data to be considered valid, it must meet all the acceptance criteria including accuracy, precision, and any other criteria specified for the analytical method used. The overall data quality objective for completeness during this investigation is 90 percent.

Field sampling conditions are often unpredictable and non-uniform. However, the objective of the field sampling program is to obtain

samples for all analyses required at each individual site, provide sufficient sample material to complete those analyses, and to produce QC samples that represent all possible contamination situations; i.e., contamination during sample collection, transportation, and storage. The field sampling completeness goal is 100 percent.

Samples for which critical data points (not identified at this point) fail the accuracy, precision, interference, or contamination data quality objectives may be reanalyzed (providing adequate sample volume and holding times are met) or resampled (with approval of the Project Manager) to meet data quality objectives.

1.4.1.4 Representativeness - Representativeness is defined by the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. If the same results are reproducible, the data obtained can be said to represent the environmental condition. Representativeness is ensured by collecting sufficient samples of an environmental medium, properly chosen with respect to place and time. The precision of a representative set of samples reflects the degree of variability of the sampled medium, as well as the effectiveness of the sampling techniques and laboratory analysis. The methods and protocols used to select samples that are representative of a particular sampling site are described in the Sampling and Analysis Plan.

1.4.1.5 Comparability - Comparability is defined by the confidence with which one data set can be compared to another. Field and laboratory procedures affect comparability. To optimize comparability, only the EPA established methods and protocols that have been selected or specified as appropriate for this

investigation will be used to collect and analyze samples. By using specific sampling and analytical procedures, all data sets will be comparable between Scott AFB and other sites nationwide to ensure that decisions and priorities are based on a consistent data base.

#### 1.4.2 Goals

Our goals for this project are designed to be realistic, achievable and ensure field and analytical data quality. Method specific goals for precision and accuracy are presented in Section 1.13.2. Representativeness and comparability are qualitative goals. To ensure representativeness of samples collected for ground water, a minimum of three well volumes will be purged before sampling the monitoring wells to ensure standing water is removed. Soil representativeness will be ensured through the thorough mixing of the sample.

Comparability goals will be established by adhering to the use of standard, published sampling and analytical methods and the use of QC samples. The completeness goal (valid data) for Scott AFB data will be 90 percent. Failure to meet these goals may result in qualification of the data, non-use of the data, or resampling.

#### 1.5 SAMPLING PROCEDURES

Sampling procedures consist of sample collection, transport and storage protocols. These protocols which pertain to the field activities are presented in detail in the Field Sampling Plan and are only referenced here.

### 1.5.1 Sampling Protocols

Sample collection, transport and storage references to be used at Scott AFB are the following:

- Practical Guide for Ground-Water Sampling, EPA 600/2-85/104, September, 1985.
- Test Methods for Evaluating Solid Wastes, Third Edition, EPA SW-846, Volume II, November, 1986.
- Handbook to Support the Installation Restoration Program (IRP) Statements of Work, IRP Division Staff, May 1991.

Detailed sampling protocols are presented in the Field Sampling Plan.

### 1.5.2 Sample Handling

The sample containers, sample volume, method of preservation, and holding times for each sample matrix are presented in Table 1-3. Since high levels of residual chlorine are not expected in the aqueous samples being collected, ascorbic acid and sodium thiosulfate will not be added as a preservative.

### 1.6 SAMPLE CUSTODY

Sample custody procedures during the collection of samples in the field and sample receipt in the laboratory are discussed in the following subsections.

TABLE 1-3

SAMPLE CONTAINERS, AMOUNTS AND PRESERVATIONS  
FOR LAW ENVIRONMENTAL NATIONAL LABORATORIES  
Scott Air Force Base, IL

*soil gas*

*min for in-facet sed.*

MATRIX	METHOD NO.	PARAMETER	CONTAINER (a,b,c)	AMOUNT	PRESERVATION	HOLDING TIMES	
						EXTRACTION	ANALYSIS
SOIL/SEDIMENT	SW 8240	Volatile Organics	One California Brass Ring	full; no headspace	Cool to 4°C	--	14 days
	SW 8270	Semi-Volatile Organics	One 8 oz glass jar	7/8 full	Cool to 4°C	14 days	40 days
	SW 6010 SW 7060 SW 7421 SW 7740 SW 7841 SW 7471	Metals, total ICP Screen Arsenic Lead Selenium Thallium Mercury	One 8 oz glass jar	7/8 full	Cool to 4°C	-- -- -- -- -- --	6 mos 6 mos 6 mos 6 mos 6 mos 28 days
	SW 9010	Cyanide	One 8 oz glass jar	7/8 full	Cool to 4°C	--	14 days
	LUFT CAL DHS	TPH	One 8 oz glass jar	7/8 full	Cool to 4°C	--	28 days
	SW 8080	Pesticides/PCBs	One 8 oz glass jar	7/8 full	Cool to 4°C	14 days	40 days
	SW 8330	Explosives	One 4 oz glass jar	7/8 full	Cool to 4°C	14 days	40 days

*soil gas + g.w. field G.L.*

TABLE 1-3

**SAMPLE CONTAINERS, AMOUNTS AND PRESERVATIONS  
FOR LAW ENVIRONMENTAL NATIONAL LABORATORIES  
Scott Air Force Base, IL**

*fuel GC - VOC >*

MATRIX	METHOD NO.	PARAMETER	CONTAINER (a,b,c)	AMOUNT	PRESERVATION	HOLDING TIMES	
						EXTRACTION	ANALYSIS
GROUND WATER / SURFACE WATER	SW 8240	Volatile Organics	Three 40 ml glass VOA vials	full; no headspace	HCl to pH < 2; Cool to 4°C	--	14 days
	SW 8270	Semi-Volatile Organics	Two 1 L glass amber bottles	7/8 full	Cool to 4°C	7 days	40 days
	SW 6010 SW 7060 SW 7421 SW 7740 SW 7841 SW 7470	Metals, total ICP Screen Arsenic Lead Selenium Thallium Meucury	One 1 L polyethylene	7/8 full	HNO <sub>3</sub> to pH < 2;	-- -- -- -- -- --	6 mos 6 mos 6 mos 6 mos 6 mos 28 days
	SW 6010 SW 7060 SW 7421 SW 7740 SW 7470	Metals, dissolved ICP Screen Arsenic Lead Selenium Mercury	One 1 L polyethylene bottle	7/8 full	Filter with 0.45 micron; HNO <sub>3</sub> to pH < 2; Cool to 4°C	-- -- -- -- --	6 mos 6 mos 6 mos 6 mos 28 days
	SW 9012	Cyanide	One 1 L polyethylene bottle	7/8 full	NaOH to pH > 12 Cool to 4°C	--	14 days
	LUFT CAL DHS	TPH	Two 1 L glass amber bottles	7/8 full	HCl to pH < 2; Cool to 4°C	7 days	28 days
	SW 8080	Pesticides/PCBs	Two 1 L glass amber bottles	7/8 full	Cool to 4°C	7 days	40 days
	EPA 160.1	TDS	One 1 L polyethylene bottle	7/8 full	Cool to 4°C	--	7 days
	SW 8330	Explosives	Two 1 L glass amber bottles	7/8 full	Cool to 4°C	7 days	40 days

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TABLE 1-3

**SAMPLE CONTAINERS, AMOUNTS AND PRESERVATIONS  
FOR LAW ENVIRONMENTAL NATIONAL LABORATORIES  
Scott Air Force Base, IL**

MATRIX	METHOD NO.	PARAMETER	CONTAINER (a,b,c)	AMOUNT	PRESERVATION	HOLDING TIMES	
						EXTRACTION	ANALYSIS
DECONTAMINATION WATER	SW 1311	TCLP	Three 1 L glass amber bottles	7/8 full	Cool to 4°C	**	**
		Volatiles	Three 40 ml VOA vials	full, no headspace	Cool to 4°C	**	**
		Semi-volatiles				**	**
		Metals (except Hg)				**	**
DRILL CUTTINGS	SW 1311	Mercury				**	**
		TCLP	One 8 oz glass jar	7/8 full	Cool to 4°C	**	**
		Volatiles	One California Brass Ring	full, no headspace	Cool to 4°C	**	**
		Semi-volatiles				**	**
		Metals (except Hg)				**	**
		Mercury				**	**

\*\* TCLP = Toxicity Characteristic Leaching Procedure, TCLP analyses and associated holding times are:

Parameter	Field Collection to TCLP Extraction	TCLP Extraction to Preparative Extraction	Preparative Extraction to Determinative Analysis	Total Elapsed Time
Volatiles	14 d	NA	14 d	28 d
Semi-volatiles	14 d	7 d	40 d	54 d
Metals (except Hg)	180 d	NA	180 d	360 d
Mercury	28 d	NA	28 d	56 d

(a) = All glass containers have teflon lids; VOA vials have teflon lined septa; California brass rings will be covered with a teflon disk and plastic end caps; polyethylene bottles have polyethylene lids

(b) = Samples chosen for QA analysis require double the number of containers indicated

(c) = Samples chosen for MS/MSD require triple the number of containers indicated

TRPH = Total Recoverable Petroleum Hydrocarbons

TDS = Total Dissolved Solids



### 1.6.1 Field Operations

The objectives of this RI are to determine the nature and extent of contamination at the sites and to develop data to be used in subsequent feasibility and treatability studies. These objectives will be accomplished through the performance of a hydropunch and soil gas survey, installation and sampling of wells, drilling of soil borings, pump tests, establishing background conditions through the collection of ground-water and soil samples, sample collection, sample custody, and chemical analysis. These field activities are presented in detail in Section 2.2 of the Field Sampling Plan.

Sample custody in the field starts with the labeling of each sample, the collection and preservation of the sample and the packaging of samples for shipment to the laboratory. Proper documentation of all field samples collected are achieved by filling out the log book, the Field Sampling Form, and a chain-of-custody (C-O-C) record for each shipment. All C-O-Cs will have the following information: project name and number, sampling date and time, sample matrix and type, number and type of container, sample number, sampler's signature and the signature of the person relinquishing the samples to the carrier. A Request for Analyses Form will accompany all samples during shipment to the laboratory. The field leader will keep a copy of the C-O-C and call the laboratory daily to see if samples were received intact and cool. This and all phone contacts will be documented.

A subcontractor will be collecting hydropunch and soil-gas samples. The sample containers will be labeled immediately after collection. The sample containers for soil gas sampling are placed in plastic bags and shipped to the subcontractor's home laboratory for analysis. The Hydropunch samples are taken to the mobile lab located on site and analyzed.

*provide address in PO&R*

## 1.6.2 Laboratory Operations


1.6.2.1 Sample Handling - The individual receiving the samples for LENL is the Sample Custodian. The Sample Custodian will perform the following actions:

- Document whether the individual samples, boxes, or ice chests were sealed upon receipt and document any damaged condition of sample container in the "remarks" section of the logbook. Custody seals are presented in Figure 1-4.
- Sign all chain-of-custody records, and identify the date and time of sample receipt. The Chain-of-Custody record is presented in Figure 1-5.
- Log all samples into the Master Logbook and computer file.
- Place sample numbers (from Master Logbook) on all sample containers and secure the samples in appropriate refrigeration unit.


1.6.2.2 Sample Identification - Upon receipt of samples by the LENL laboratory, each field sample is assigned a laboratory sample number. This number consists of two letters and 5 digits. An example of a laboratory sample number is AA00001. Upon exhaustion of digits, the two letter figure would change to AB and the numbers from 0 to 99999 would be repeated.

Batch numbers or location codes are assigned to each sample series received from a particular job. For example, if a job has several sites each batch of samples from one particular site is assigned a


FIGURE 1-4  
**CUSTODY SEAL**

 <b>LAW ENVIRONMENTAL NATIONAL LABORATORIES OFFICIAL SAMPLE SEAL</b>	SAMPLE NO	DATE	SEAL BROKEN	DATE
	SIGNATURE			
	PRINT NAME AND TITLE.			

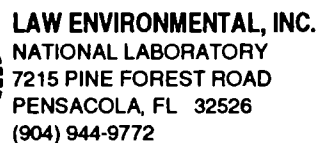
  

 <b>LAW ENVIRONMENTAL NATIONAL LABORATORIES OFFICIAL SAMPLE SEAL</b>	SAMPLE NO	DATE	SEAL BROKEN	DATE
	SIGNATURE			
	PRINT NAME AND TITLE.			

 <b>LAW ENVIRONMENTAL NATIONAL LABORATORIES OFFICIAL SAMPLE SEAL</b>	SAMPLE NO	DATE	SEAL BROKEN	DATE
	SIGNATURE			
	PRINT NAME AND TITLE.			





### FIGURE 1-5 CHAIN OF CUSTODY RECORD

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## SAMPLING INFORMATION

NAME OF FACILITY:

**STREET ADDRESS:**

CITY/STATE:

ZIP:

[illegible]

**DISTRIBUTION:** ORIGINAL AND PINK COPIES ACCOMPANY SAMPLE SHIPMENT TO LABORATORY.  
PINK COPY RETAINED BY LABORATORY. YELLOW COPY RETAINED BY SAMPLERS.

REMARKS:

\* SOURCE RECOVERY WELL - RW  
CODES: RCRA MONITORING WELL - MW  
SOIL/SEDIMENT - SO  
SLUDGE - SL  
NPDES DISCHARGE - ND  
DRINKING WATER - DW

HF



**LAW ENVIRONMENTAL, INC.**  
GOVERNMENT SERVICES DIVISION

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location code. This code is usually a word associated with the site. Location codes are also assigned to samples of different matrices from the same site.

1.6.2.3 Sample Custody Records - All samples leaving the field must at a minimum be accompanied by a chain-of-custody prior to arrival at the laboratory. The following sections discuss sample custody after receipt at the laboratory.

Incoming samples should be accompanied by an LENL Chain-of-Custody (Figure 1-5) and an Analytical Request Form (Figure 1-6) completed in the field. In the event that this form does not accompany the incoming samples, the LENL - Pensacola Sample Custodian will inform the LENL - Pensacola AFCEE Project Manager who will initiate a telephone call to the LEGS Project Manager for corrective action. The Sample Custodian will enter the Lab and Test Setup information into the computer. An Intra-Lab Chain-of-Custody Form is generated (Figures 1-7 and 1-8). The Sample Custodian will have the Intra-Lab Chain-of-Custody Form and Analytical Request Form checked and initialed by a Supervisor, and will issue copies of the Intra-Lab Chain-of-Custody Form to the applicable labs, normally on the day the samples are received.

To receive samples from the custody room, the analyst will complete the applicable portion of the Intra-Lab Chain-of-Custody Form. The analyst is responsible for custody of samples during analysis.

The analyst will return the samples to the custody room when analyses are completed. Samples will be maintained in the custody room during non-duty hours unless all analyses are complete and the sample is to be discarded. Samples which are found to be contaminated are processed either through on-site recycling, recycling thorough Chemical Conservation Corporation, removed to a Publicly Owned Treatment Works (POTW), or removed by EPA manifest

# ANALYTICAL REQUEST FORM

Date Results Requested: \_\_\_\_\_

## Method

[illegible]

HF

## Page \_\_\_\_\_ of \_\_\_\_\_

Location: \_\_\_\_\_ Callb. Ref: \_\_\_\_\_ Form Initiated: \_\_\_\_/\_\_\_\_/\_\_\_\_

**Sample Types**    **S = Sample**    **D = Digestate**

**Removal Purpose**

**Disposition**

### L - Storage

**M - Submission**

### N - Disposal

### N - Disposal

### N - Disposal

### N - Disposal

### N - Disposal

**SAMPLES CONSTITUTING THIS BATCH :**

Matrix: \_\_\_\_\_ Level: \_\_\_\_\_ # of Physical Samples: \_\_\_\_\_

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## Page \_\_\_\_ of \_\_\_\_

Location: \_\_\_\_\_ Calib. Ref: \_\_\_\_\_ Form Initiated: \_\_\_\_/\_\_\_\_/\_\_\_\_

**Sample Types**    **S = Sample**    **X = Extract**

**M - Storage**  
**N - Submission**  
**O - Disposal**

Matrix: \_\_\_\_\_ Level: \_\_\_\_\_ # of Physical Samples: \_\_\_\_\_

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to a landfill. Uncontaminated samples are either removed to a POTW or removed to a lined landfill. When the samples are returned, the analyst will complete the Sample Custody Log entry.

The Intra-Lab Chain-of-Custody Form will be maintained by the Operations Manager as a permanent file. Table 1-4 lists sample flow and documentation within the laboratory.

### 1.7 FIELD EQUIPMENT CALIBRATION PROCEDURES

Several instruments will be used in the field investigation. These instruments consist of an HNU meter, pH meter, combination temperature and specific conductance meter, and a turbidimeter. Each field meter will be calibrated before use. The calibration will be documented in the field book. Details of calibration and maintenance are presented in Section 2.3 of the Field Sampling Plan.

### 1.8 ANALYTICAL PROCEDURES

The following sections identify the methods utilized for Scott AFB and calibration procedures followed in each method.

#### 1.8.1 Sample Preparation Methods and Analytical Methods

The analytical methods utilized for Scott AFB are taken from the following references:

- Test Methods for Evaluating Solid Waste. EPA SW-846, 3rd Edition, 1986.
- Method for Chemical Analysis of Water and Wastes. EPA 600/4-79-020, March 1983.

TABLE 1-4

**LENL SAMPLE FLOW AND DOCUMENTATION CHART**  
**Scott Air Force Base, IL**

Sample Flow		Documentation
A.	Incoming Samples	<ul style="list-style-type: none"> <li>- Chain of Custody</li> <li>- Request for Analysis</li> <li>- Work Authorization</li> </ul>
B.	Log-In and Assignment	<ul style="list-style-type: none"> <li>- Master Logbook</li> <li>- Test Entry Form</li> </ul>
C.	Sample Handling and QC	
	(1) Organics Prep Lab	<ul style="list-style-type: none"> <li>- Extraction Record</li> <li>- Percent Moisture</li> <li>- Standards Prep Logs</li> <li>- QC Sample Logs</li> </ul>
	(2) GC Lab	<ul style="list-style-type: none"> <li>- Chromatograms</li> <li>- Bench Sheets</li> <li>- Condition Reports</li> <li>- Linearity Checks</li> <li>- Surrogate Recovery Logs</li> <li>- Blank, Standard and Spike Results</li> <li>- Standards Logbook</li> </ul>
	(3) GC/MS Lab	<ul style="list-style-type: none"> <li>- Instrument Maintenance Logs</li> <li>- Sample Logbook</li> <li>- Quantitation Reports</li> <li>- Chromatograms</li> <li>- Initial Calibration Forms</li> <li>- Continuing Calibration Checks</li> <li>- Surrogate Recovery Logs</li> <li>- Blank, Standard and Spike Results</li> <li>- Computer Streamer Tapes</li> <li>- Instrument Maintenance Logs</li> </ul>
	(4) Metals Lab	<ul style="list-style-type: none"> <li>- Digestion Log</li> <li>- Bench Sheets</li> <li>- Blank, Standard and Spike Results</li> <li>- Percent Moisture</li> <li>- Standards Prep Logs</li> <li>- QC Sample Logs</li> </ul>
D.	Reporting	<ul style="list-style-type: none"> <li>- Transmittal Letters</li> <li>- Test Data Reports</li> <li>- GC/MS Data Reports</li> </ul>
E.	Sample Disposal	<ul style="list-style-type: none"> <li>- Internal Sample Disposal Forms.</li> </ul>

- Annual Book of ASTM Standards. Volume 04.08 Section 4
- The Federal Register, 40 CFR 261, 13 June 1986.
- Methods for Chemical Analysis of Water and Wastewater. EPA 600/4-79-020, Revised March, 1983.
- Standard Methods for Examination of Water and Wastewater. 16th Ed., 1980, APHA, AWWA, etc.

Table 1-5 lists the analytical methods to be used for this project.

#### 1.8.2 Detection Limits and Quantification Criteria

1.8.2.1 Terminology - Each analytical parameter concentration will be reported as a specific number or less than the Instrument Detection Limit (IDL) for inorganic methods and less than the Practical Quantification Limit (PQL) for organic methods. Water values will be reported in parts per billion (ppb,  $\mu\text{g/L}$ ) concentrations for organics and in parts per million (ppm,  $\text{mg/L}$ ) for inorganics. Soil values will be reported in ppb ( $\mu\text{g/Kg}$ ) for the organic analyses, and in parts per million (ppm,  $\text{mg/Kg}$ ) for the metals analyses.

The Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the value is above zero.

1.8.2.2 Procedures - The following procedures are used to establish limits of detection and quantification.

**TABLE 1-5**  
**ANALYTICAL TEST METHODS**  
**Scott Air Force Base, IL**

<u>PARAMETER</u>	<u>METHOD</u>
Matrix: Water	
pH	EPA 150.1
Conductance	EPA 120.1
Temperature	EPA 170.1
✓ Total Dissolved Solids	EPA 160.1
✓ Volatile Organics	SW 8240
✓ Semi-volatile Organics	SW 3510/8270
✓ Metals (total and dissolved)	
ICP Screen	SW 3005/6010
Arsenic	SW 7060
Lead	SW 3020/7421 **
Selenium	SW 7740
Thallium	SW 3020/7841
Mercury	SW 7470
✓ Pesticides/PCBs	SW 3510/8080
✓ Cyanide	SW 9010
Total Petroleum Hydrocarbons ✓	LUFT CAL DHS
✓ Explosives	SW 8330
Matrix: Soil	
✓ Volatile Organics	SW 8240
✓ Semi-volatile Organics	SW 3550/8270
✓ Metals (total)	
ICP Screen	SW 3050/6010
Arsenic	SW 3050/7060
Lead	SW 3050/7421 **
Selenium	SW 3050/7740
Thallium	SW 3050/7841
Mercury	SW 7471
✓ Pesticides/PCBs	SW 3550/8080
✓ Cyanide	SW 9010
Total Petroleum Hydrocarbons ✓	LUFT CAL DHS

\*\* If the lead concentration detected on the ICP is >5x the instrument detection limit (IDL) on the ICP, the ICP value can be used. If the lead concentration detected on the ICP is <5x the IDL on the ICP, then the GFAA analysis is required.

### Method Detection Limit (MDL)

Method Detection Limits (MDL) limits are established using the required EPA procedure specified in 40 CFR Part 136 Appendix B. A data pool is generated of at least seven standards analyzed at a concentration approximately 3X the anticipated MDL. The MDL is estimated by employing the "t" distribution with a 99 percent confidence interval by the following equation:

$$MDL = (t) (S)$$

where

t - is a factor for n-1 degrees of freedom  
at the 99% confidence factor  
S - is the standard deviation of the data  
pool

Instrument Detection Limits (IDL) are established by the EPA CLP protocol. A data pool is generated by analyzing a minimum of seven standards at 3X the anticipated IDL on three non-consecutive days. The standard deviation (S) of the seven data points for each of the three days is calculated and the IDL established by the following equation:

$$IDL = \frac{S1 + S2 + S3}{3} * 3$$

Practical Quantification Limits (PQL) in the common sense are a function of sample matrix but in the limit of a matrix devoid of any interferences PQL is calculated as follows:

$$PQL = F * S$$

where

S - is the standard deviation of the data used to determine MDL

F - is a factor between 1 and 10 based on chromatographic behavior.

The matrix used for these studies is spiked reagent water processed through the appropriate analytical procedure.

1.8.2.3 Values - The laboratory established detection and quantitation limits are listed in Table 1-6.

### 1.8.3 Method Calibration

The calibration procedures, preparation of calibration standards, and frequency of initial and continuing calibration checks are described for each analytical method in the following subsections.

At a minimum, all instruments and other equipment used by Law will be calibrated and maintained at the recommended intervals prescribed by the analytical method employed. In those cases where it has been demonstrated that more frequent calibration or maintenance is required, the base method will be enhanced as necessary. Calibration checks and preventive maintenance procedures are permanently recorded in a log book for future reference. Whenever possible, calibration checks on instruments and support equipment are performed using reference materials (e.g., weights) which are traceable to the EPA Environmental Monitoring Systems Laboratory (EMSL) or bear certificates of standardization from the National Institute of Standards and Technology (NIST).

TABLE 1-6  
LABORATORY – ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
INORGANICS

Parameter	Method	Units	Matrix	IDL
Aluminum	SW 6010	mg/L	Water	0.5
		mg/kg	Soil	50
Antimony	SW 6010	mg/L	Water	0.1
		mg/kg	Soil	10
Arsenic	SW 7060	mg/L	Water	0.005
		mg/kg	Soil	0.5
Barium	SW 6010	mg/L	Water	0.05
		mg/kg	Soil	5
Beryllium	SW 6010	mg/L	Water	0.001
		mg/kg	Soil	0.1
Cadmium	SW 6010	mg/L	Water	0.005
		mg/kg	Soil	0.5
Calcium	SW 6010	mg/L	Water	1
		mg/kg	Soil	100
Chromium	SW 6010	mg/L	Water	0.01
		mg/kg	Soil	1
Cobalt	SW 6010	mg/L	Water	0.01
		mg/kg	Soil	1
Copper	SW 6010	mg/L	Water	0.01
		mg/kg	Soil	1
Cyanide	SW 9010	mg/L	Water	0.005
		mg/kg	Soil	0.5
Iron	SW 6010	mg/L	Water	0.05
		mg/kg	Soil	5
Lead	SW 6010	mg/L	Water	0.05
		mg/kg	Soil	5
Lead	SW 7421	mg/L	Water	0.005
		mg/kg	Soil	0.5
Magnesium	SW 6010	mg/L	Water	0.5
		mg/kg	Soil	50
Manganese	SW 6010	mg/L	Water	0.005
		mg/kg	Soil	0.5
Mercury	SW 7470	mg/L	Water	0.001
	SW 7471	mg/kg	Soil	0.1
Molybdenum	SW 6010	mg/L	Water	0.05
		mg/kg	Soil	5
Nickel	SW 6010	mg/L	Water	0.05
		mg/kg	Soil	5
Potassium	SW 6010	mg/L	Water	1
		mg/kg	Soil	100
Selenium	SW 7740	mg/L	Water	0.005
		mg/kg	Soil	0.5
Silver	SW 6010	mg/L	Water	0.05
		mg/kg	Soil	5
Sodium	SW 6010	mg/L	Water	0.5
		mg/kg	Soil	50
Thallium	SW 7841	mg/L	Water	0.003
		mg/kg	Soil	0.30
Vanadium	SW 6010	mg/L	Water	0.008
		mg/kg	Soil	0.8
Zinc	SW 6010	mg/L	Water	0.008
		mg/kg	Soil	0.8

IDL – Instrument Detection Limit

Note: Metal results will be reported down to the IDL.

TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
VOLATILE ORGANICS  
SW 8240

Parameter	Units	Matrix	MDL	PQL
Acetone	µg/L	Water	7.5	10
	mg/kg	Soil	—	0.01
Benzene	µg/L	Water	0.4	1
	mg/kg	Soil	—	0.001
Bromodichloromethane	µg/L	Water	0.3	1
	mg/kg	Soil	—	0.001
Bromoform	µg/L	Water	0.2	5
	mg/kg	Soil	—	0.005
Bromomethane	µg/L	Water	0.7	1
	mg/kg	Soil	—	0.001
2-Butanone (MEK)	µg/L	Water	2.8	10
	mg/kg	Soil	—	0.01
Carbon disulfide	µg/L	Water	0.7	5
	mg/kg	Soil	—	0.005
Carbon tetrachloride	µg/L	Water	0.4	5
	mg/kg	Soil	—	0.005
Chlorobenzene	µg/L	Water	0.2	5
	mg/kg	Soil	—	0.005
Chloroethane	µg/L	Water	0.3	5
	mg/kg	Soil	—	0.005
2-Chloroethyl vinyl ether	µg/L	Water	8	10
	mg/kg	Soil	—	0.01
Chloroform	µg/L	Water	0.3	5
	mg/kg	Soil	—	0.005
Chloromethane	µg/L	Water	0.6	1
	mg/kg	Soil	—	0.001
Dibromochloromethane	µg/L	Water	0.3	5
	mg/kg	Soil	—	0.005
1,1-Dichloroethane	µg/L	Water	0.3	5
	mg/kg	Soil	—	0.005
1,2-Dichloroethane	µg/L	Water	0.4	5
	mg/kg	Soil	—	0.005
1,1-Dichloroethene	µg/L	Water	0.3	5
	mg/kg	Soil	—	0.005
trans-1,2-Dichloroethene	µg/L	Water	0.4	5
	mg/kg	Soil	—	0.005
1,2-Dichloropropane	µg/L	Water	0.6	1
	mg/kg	Soil	—	0.001
cis-1,3-Dichloropropene	µg/L	Water	0.6	1
	mg/kg	Soil	—	0.001
trans-1,3-Dichloropropene	µg/L	Water	0.2	5
	mg/kg	Soil	—	0.005
Ethylbenzene	µg/L	Water	0.2	5
	mg/kg	Soil	—	0.005
2-Hexanone	µg/L	Water	2.1	5
	mg/kg	Soil	—	0.005
Methylene chloride	µg/L	Water	4.5	5
	mg/kg	Soil	—	0.005
4-Methyl-2-pentanone	µg/L	Water	7	10
	mg/kg	Soil	—	0.01



TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
VOLATILE ORGANICS  
SW 8240

Parameter	Units	Matrix	MDL	PQL
Styrene	µg/L	Water	0.5	5
	mg/kg	Soil	–	0.005
1,1,2,2–Tetrachloroethane	µg/L	Water	0.7	5
	mg/kg	Soil	–	0.005
Tetrachloroethene	µg/L	Water	0.2	5
	mg/kg	Soil	–	0.005
Toluene	µg/L	Water	0.3	5
	mg/kg	Soil	–	0.005
1,1,1–Trichloroethane	µg/L	Water	0.4	5
	mg/kg	Soil	–	0.005
1,1,2–Trichloroethane	µg/L	Water	0.7	5
	mg/kg	Soil	–	0.005
Trichloroethene	µg/L	Water	0.2	5
	mg/kg	Soil	–	0.005
Vinyl acetate	µg/L	Water	0.7	10
	mg/kg	Soil	–	0.01
Vinyl chloride	µg/L	Water	0.6	2
	mg/kg	Soil	–	0.002
Xylenes (total)	µg/L	Water	0.7	5
	mg/kg	Soil	–	0.005

MDL – Method Detection Limit

PQL – Practical Quantitation Limit

Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable. The PQLs listed for soil/sediment are based on wet weight. Normally data is reported on a dry weight basis; therefore, PQLs will be higher, based on the percent moisture in each sample.

TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
PESTICIDES / PCBs  
SW 8080

Parameter	Units	Matrix	MDL	PQL
Aldrin	ug/L	Water	0.02	0.04
	mg/kg	Soil	-	0.0013
alpha-BHC	ug/L	Water	0.01	0.03
	mg/kg	Soil	-	0.0010
beta-BHC	ug/L	Water	0.05	0.05
	mg/kg	Soil	-	0.0016
delta-BHC	ug/L	Water	0.01	0.01
	mg/kg	Soil	-	0.0003
gamma-BHC (Lindane)	ug/L	Water	0.04	0.04
	mg/kg	Soil	-	0.0013
Chlordane	ug/L	Water	1	1
	mg/kg	Soil	-	0.03
4,4'-DDD	ug/L	Water	0.03	0.1
	mg/kg	Soil	-	0.003
4,4'-DDE	ug/L	Water	0.02	0.04
	mg/kg	Soil	-	0.0013
4,4'-DDT	ug/L	Water	0.03	0.1
	mg/kg	Soil	-	0.003
Dieldrin	ug/L	Water	0.02	0.05
	mg/kg	Soil	-	0.0017
Endosulfan I	ug/L	Water	0.02	0.04
	mg/kg	Soil	-	0.0013
Endosulfan II	ug/L	Water	0.03	0.1
	mg/kg	Soil	-	0.003
Endosulfan sulfate	ug/L	Water	0.04	0.1
	mg/kg	Soil	-	0.003
Endrin	ug/L	Water	0.07	0.07
	mg/kg	Soil	-	0.0023
Endrin Aldehyde	ug/L	Water	0.04	0.1
	mg/kg	Soil	-	0.003
Heptachlor	ug/L	Water	0.02	0.03
	mg/kg	Soil	-	0.001
Heptachlor epoxide	ug/L	Water	0.02	0.05
	mg/kg	Soil	-	0.0017
Methoxychlor	ug/L	Water	0.2	0.4
	mg/kg	Soil	-	0.013
Toxaphene	ug/L	Water	5	5
	mg/kg	Soil	-	0.16
PCB-1016	mg/kg	Water	1	1
	ug/L	Soil	-	0.03
PCB-1221	mg/kg	Water	2	2
	mg/kg	Soil	-	0.07
PCB-1232	ug/L	Water	1	1
	mg/kg	Soil	-	0.03

TABLE 1-6  
 LABORATORY-ESTABLISHED DETECTION AND  
 QUANTITATION LIMITS  
 SCOTT AFB, ILLINOIS  
 PESTICIDES / PCBs  
 SW 8080

Parameter	Units	Matrix	MDL	PQL
PCB-1242	ug/L	Water	1	1
	mg/kg	Soil	—	0.03
PCB-1248	ug/L	Water	1	1
	mg/kg	Soil	—	0.03
PCB-1254	ug/L	Water	1	1
	mg/kg	Soil	—	0.03
PCB-1260	ug/L	Water	1	1
	mg/kg	Soil	—	0.03

MDL – Method Detection Limit

PQL – Practical Quantitation Limit

Sample PQLs are highly matrix dependent. The PQLs listed herein are provided for guidance and may not always be achievable. PQLs listed for soil / sediment are based on wet weight. Normally, data is reported on a dry weight basis; therefore PQLs will be higher based on the percent moisture in each sample.

TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
SEMIVOLATILE ORGANIC COMPOUNDS  
SW 8270

Parameter	Units	Matrix	MDL	PQL
Acenaphthene	ug/L	Water	0.4	1
	mg/kg	Soil	—	0.033
Acenaphthylene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Anthracene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Benzo[a]anthracene	ug/L	Water	0.4	1
	mg/kg	Soil	—	0.033
Benzo[b]fluoranthene	ug/L	Water	0.8	1
	mg/kg	Soil	—	0.033
Benzo[k]fluoranthene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Benzoic acid	ug/L	Water	36	50
	mg/kg	Soil	—	1.65
Benzo[ghi]perylene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Benzo[a]pyrene	ug/L	Water	0.3	1
	mg/kg	Soil	—	0.033
Benzyl alcohol	ug/L	Water	1.7	2
	mg/kg	Soil	—	0.066
bis(2-Chloroethoxy)methane	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
bis(2-Chloroethyl)ether	ug/L	Water	0.9	1
	mg/kg	Soil	—	0.033
bis(2-Chloroisopropyl)ether	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
bis(2-ethylhexyl)phthalate	ug/L	Water	1.3	2
	mg/kg	Soil	—	0.066
4-Bromophenyl phenyl ether	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Butyl benzyl phthalate	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
4-Chloroaniline	ug/L	Water	4.8	5
	mg/kg	Soil	—	0.165
4-Chloro-3-methylphenol	ug/L	Water	0.8	1
	mg/kg	Soil	—	0.033
2-Chloronaphthalene	ug/L	Water	0.4	1
	mg/kg	Soil	—	0.033
2-Chlorophenol	ug/L	Water	1	1
	mg/kg	Soil	—	0.033
4-Chlorophenyl phenyl ether	ug/L	Water	0.4	1
	mg/kg	Soil	—	0.033
Chrysene	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
Dibenz[a,h]anthracene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Dibenzofuran	ug/L	Water	0.4	1
	mg/kg	Soil	—	0.033
Di-n-butylphthalate	ug/L	Water	1	1
	mg/kg	Soil	—	0.033

TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
SEMIVOLATILE ORGANIC COMPOUNDS  
SW 8270

Parameter	Units	Matrix	MDL	PQL
1,2-Dichlorobenzene	ug/L	Water	0.7	1
	mg/kg	Soil	—	0.033
1,3-Dichlorobenzene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
1,4-Dichlorobenzene	ug/L	Water	0.7	1
	mg/kg	Soil	—	0.033
3,3'-Dichlorobenzidine	ug/L	Water	2	2
	mg/kg	Soil	—	0.066
2,4-Dichlorophenol	ug/L	Water	0.9	1
	mg/kg	Soil	—	0.033
Diethylphthalate	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
3,3'-Dimethylbenzidine	ug/L	Water	2	2
	mg/kg	Soil	—	0.066
2,4-Dimethylphenol	ug/L	Water	1	1
	mg/kg	Soil	—	0.033
Dimethylphthalate	ug/L	Water	0.3	1
	mg/kg	Soil	—	0.033
4,6-Dinitro-2-methylphenol	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
2,4-Dinitrophenol	ug/L	Water	3.3	20
	mg/kg	Soil	—	0.66
2,4-Dinitrotoluene	ug/L	Water	0.8	1
	mg/kg	Soil	—	0.033
2,6-Dinitrotoluene	ug/L	Water	0.8	1
	mg/kg	Soil	—	0.033
Di-n-octylphthalate	ug/L	Water	0.7	1
	mg/kg	Soil	—	0.033
Fluoranthene	ug/L	Water	0.6	1
	mg/kg	Soil	—	0.033
Fluorene	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
Hexachlorobenzene	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
Hexachlorobutadiene	ug/L	Water	0.7	1
	mg/kg	Soil	—	0.033
Hexachlorocyclopentadiene	ug/L	Water	1.8	2
	mg/kg	Soil	—	0.066
Hexachloroethane	ug/L	Water	0.9	1
	mg/kg	Soil	—	0.033
Indeno[1,2,3-cd]pyrene	ug/L	Water	1.6	2
	mg/kg	Soil	—	0.066
Isophorone	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
2-Methylnaphthalene	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
2-Methylphenol	ug/L	Water	0.8	1
	mg/kg	Soil	—	0.033
4-Methylphenol	ug/L	Water	0.9	1
	mg/kg	Soil	—	0.033
Naphthalene	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033

TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
SEMIVOLATILE ORGANIC COMPOUNDS  
SW 8270

Parameter	Units	Matrix	MDL	PQL
2-Nitroaniline	ug/L	Water	0.7	5
	mg/kg	Soil	—	0.165
3-Nitroaniline	ug/L	Water	1	5
	mg/kg	Soil	—	0.165
4-Nitroaniline	ug/L	Water	4	5
	mg/kg	Soil	—	0.165
Nitrobenzene	ug/L	Water	0.9	1
	mg/kg	Soil	—	0.033
2-Nitrophenol	ug/L	Water	0.9	1
	mg/kg	Soil	—	0.033
4-Nitrophenol	ug/L	Water	2	20
	mg/kg	Soil	—	0.66
n-Nitrosodiphenylamine	ug/L	Water	1	1
	mg/kg	Soil	—	0.033
n-Nitrosodipropylamine	ug/L	Water	1	1
	mg/kg	Soil	—	0.33
Pentachlorophenol	ug/L	Water	0.6	10
	mg/kg	Soil	—	0.33
Phenanthrene	ug/L	Water	0.4	1
	mg/kg	Soil	—	0.033
Phenol	ug/L	Water	0.8	1
	mg/kg	Soil	—	0.033
Pyrene	ug/L	Water	0.7	1
	mg/kg	Soil	—	0.033
1,2,4-Trichlorobenzene	ug/L	Water	0.5	1
	mg/kg	Soil	—	0.033
2,4,5-Trichlorophenol	ug/L	Water	1	1
	mg/kg	Soil	—	0.033
2,4,6-Trichlorophenol	ug/L	Water	0.7	1
	mg/kg	Soil	—	0.033

MDL – Method Detection Limit  
PQL – Practical Quantitation Limit

Sample PQLs are highly matrix dependent. The PQLs listed herein are provided for guidance and may not always be achievable. PQLs listed for soil / sediment are based on wet weight. Normally, data is reported on a dry weight basis; therefore PQLs will be higher based on the percent moisture in each sample.

TABLE 1-6  
LABORATORY-ESTABLISHED DETECTION AND  
QUANTITATION LIMITS  
SCOTT AFB, ILLINOIS  
EXPLOSIVES  
SW 8330

Parameter	Units	Matrix	MDL*	PQL*
HMX	ug/L	Water	2	2
	mg/kg	Soil	—	2
RDX	ug/L	Water	1	1
	mg/kg	Soil	—	1
1,3,5-TNB	ug/L	Water	1	1
	mg/kg	Soil	—	1
Tetryl	ug/L	Water	2	2
	mg/kg	Soil	—	2
1,3-DNB	ug/L	Water	2	2
	mg/kg	Soil	—	2
Nitrobenzene	ug/L	Water	2	2
	mg/kg	Soil	—	2
2,4,6-TNT	ug/L	Water	1	1
	mg/kg	Soil	—	1
2,4-DNT	ug/L	Water	1	1
	mg/kg	Soil	—	1
2,6-DNT	ug/L	Water	1	1
	mg/kg	Soil	—	1
o-Nitrotoluene	ug/L	Water	1	1
	mg/kg	Soil	—	1
p-Nitrotoluene	ug/L	Water	2	2
	mg/kg	Soil	—	2
m-Nitrotoluene	ug/L	Water	2	2
	mg/kg	Soil	—	2

MDL – Method Detection Limit

PQL – Practical Quantitation Limit

\*MDLs and PQLs are arbitrarily set

TOTAL PETROLEUM HYDROCARBONS  
LUFT CAL DHS

Parameter	Units	Matrix	MDL	PQL
Gasoline	mg/L	Water	0.074	0.5
	mg/kg	Soil	—	0.5
Diesel	mg/L	Water	0.072	0.5
	mg/kg	Soil	—	16.5

MDL – Method Detection Limit

PQL – Practical Quantitation Limit

Sample PQLs are highly matrix dependent. The PQLs listed herein are provided for guidance and may not always be achievable. PQLs listed for soil / sediment are based on wet weight. Normally, data is reported on a dry weight basis; therefore PQLs will be higher based on the percent moisture in each sample.

All chemical standards used by Law are certified to have the highest reasonable purity with assays or certificates of analysis provided with material. All materials are purchased from established and reputable chemical dealers. All standard materials are dated and stored under appropriate conditions in order to maintain chemical stability. Each time a specific standard is prepared, the material mass and dilution information is recorded in the standards record book. All prepared standards (stock and working) are labeled in reference to the book number, page number, and entry number of the Analytical Standards Preparations Record Book. Additionally, the description, date, and analyst are given on the standard label.

*Provid* 1.8.3.1 Organics by Gas Chromatography (GC) with Second Column Confirmation - Pesticides/PCBs analyzed on the GC will follow EPA Methods while TPHs analyzed on the GC will follow CAL.DHS methods. The CAL.DHS method utilizes gas chromatography but does not require second column confirmation. Second column confirmation is required for samples which exhibit a positive Pesticide/PCB result. The confirmation system must contain a dissimilar column and is calibrated and subject to the same QC as the primary GC system. The primary or secondary result may be reported. The two results will not be averaged.

Prior to calibration, retention time windows for each standard on each GC column are determined whenever a new GC column is installed as follows.

Three injections of each standard are made over a 72-hour period at approximately equal intervals. A standard deviation is calculated from the three absolute retention times. For multi-response analytes, one major peak is chosen from the envelope for the retention time study. Retention time windows for each analyte are updated daily and are equal to the continuing calibration analyte



retention time plus or minus three times the standard deviation determined in the study. If the retention time window for an analyte is zero, a standard deviation of a similar compound is used.

Tentative identification of an analyte occurs when a peak from a sample falls within the daily retention time window. Multi-response analytes are identified primarily by pattern recognition.

Calibration procedures for both systems are presented below.

1. GC system is checked daily prior to analysis of samples by reviewing temperatures to injector parts, detectors and columns, verifying that the system is method specific to ensure reliability and reproducibility of analytical results.
2. GC is calibrated with five standards and a calibration blank using external standard technique.
3. If the %RSD of the RF (internal standard technique) or CF (external standard technique) for the 5 standards is less than or equal to 20 percent, then the average RF is used for quantitation. If the RSD of the RF is greater than 20 percent, a calibration curve is established by plotting response versus amount.
4. After development of each new five-point calibration and at the start of every analysis day, a mid-point daily initial calibration verification (ICV) containing all single peak analytes of interest is run. Pesticide/PCB standards also include Toxaphene, Chlordane, and Aroclors 1016/1260. The standard's RF or CF must agree with the initial calibration average RF or CF within  $\pm 15$  percent difference (%D). For a calibration curve, the

concentration of the mid-point initial calibration standard is compared to the ICV concentration. The percent recovery of the ICV is obtained using the following formula: ICV Found Value divided by Mid-point Initial Calibration True Value (calculated from the curve) X 100. The percent recovery of the ICV must be within  $\pm 15$  percent.

5. After every 10 samples within the sequence and at the end of the sequence, a mid-level continuing calibration verification (CCV) is analyzed which must be within  $\pm 15\%$  D of the ICV. For a calibration curve, the concentration of the ICV is compared to the concentration of the CCV. The percent recovery of the CCV must be within  $\pm 15\%$ .
6. The retention time (RT) for all identified analytes in an analytical run must fall within the RT windows calculated for the analytical standards.
7. Second column confirmation which is required for samples exhibiting positive results is subject to the same acceptance criteria as was the first column.

1.8.3.2 Volatile and Semi-Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS) - Analyses performed on the GC/MS will follow EPA Methods. This includes the following calibration procedure:

1. Instrument calibration will be performed every 12-hour time period. The GC/MS will be tuned to meet ion abundance criteria given in Tables 1-7 and 1-8 for decafluorotriphenylphosphine (DFTPP) or 4-Bromofluorobenzene (BFB).

**TABLE 1-7**  
**DFTPP KEY IONS AND ABUNDANCE CRITERIA\***  
**Scott Air Force Base, IL**

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

\*J.W. Eichelberger, L.E. Harris, and W.L. Budde. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectrometry," *Analytical Chemistry*, 47, 995 (1975).

**TABLE 1-8**  
**BFB KEY IONS AND ABUNDANCE CRITERIA\***

MASS	ION ABUNDANCE CRITERIA
50	15-40% of mass 95
75	30-60% of mass 95
95	base peak, 100% relative abundance
96	5-9% of mass 95
173	less than 2% of mass 174
174	less than 50% of mass 95
175	5-9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5-9% of mass 176

\* EPA Method 8240, SW-846, 3rd Edition, November 1986.

2. Initial calibration will be performed on calibration standards at five concentration levels containing each compound of interest and each surrogate standard.

The relative retention time (RRT) of each compound in each calibration run should agree within 0.06 RRT units. The average relative response factor (RRF) and percent relative standard deviation (%RSD) is calculated for each compound. The RRF for the System Performance Check Compounds (SPCC: Volatiles: Chloromethane, 1,1-Dichloroethane, Bromoform, 1,2,2-Tetrachloroethane, Chlorobenzene. Semi-volatiles: N-nitroso-di-n-propylamine, Hexachlorocyclopentadiene, 2,4-Dinitrophenol, 4-Nitrophenol) must be  $\geq 0.300$  (0.250 for Bromoform) for volatiles and must be  $\geq 0.050$  for semi-volatiles. The %RSD for the Calibration Check compounds (CCC: Volatiles - Vinyl chloride, 1,1-Dichloroethene, Chloroform, 1,2-Dichloropropane, Toluene, Ethylbenzene; Semi-volatiles Base/Neutrals - Acenaphthene, 1,4-Dichlorobenzene, Hexachlorobutadien, N-Nitroso-di-n-phenylamine, Di-n-octylphthalate, Fluoranthene, Benzo(a)pyrene; Acids - 4-Chloro-3-methylphenol, 2,4-Dichlorophenol, 2-Nitrophenol, Phenol, Pentachlorophenol, 2,4,6-Trichlorophenol) must be  $< 30$  percent. The %RSD for the other compounds should be less than 30 percent. If not, a notation is made in the sample documentation.

3. After the preparation of each new initial five-point calibration curve and after tune criteria are met for each 12-hour time period, the initial calibration is verified (using a midpoint calibration standard containing all analytes) prior to running any samples. This initial calibration verification (ICV) must satisfy the above SPCC criteria. In addition, the percent difference (%D) for the CCC must be  $\leq 25$  percent for the

volatiles and  $\leq 30$  percent for the semi-volatiles. If these criteria are not met for any single CCC, corrective action must be taken or a new five point calibration must be performed.

4. Internal standards for GC/MS volatiles will be added to each sample, standard and reagent blank. The final concentration of each internal standard will be 50  $\mu\text{g/L}$ . The internal standards are as follows:

- Bromochloromethane
- 1,4-Difluorobenzene
- Chlorobenzene- $\text{d}_5$

Table 1-9 presents the analytes quantitated by each internal standard.

Internal standards for GC/MS semi-volatiles will be added to each sample, standard, and reagent blank. The final concentration of each internal standard will be 40 nanograms per microliter ( $\text{ng}/\mu\text{L}$ ). The internal standards are as follows:

- 1,4-Dichlorobenzene- $\text{d}_4$
- Naphthalene- $\text{d}_8$
- Acenaphthene- $\text{d}_{10}$
- Phenanthrene- $\text{d}_{10}$
- Chrysene- $\text{d}_{12}$
- Perylene- $\text{d}_{12}$

Table 1-10 presents the analytes quantitated by each internal standard.

TABLE 1-9

**VOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES  
ASSIGNED FOR QUANTITATION  
Scott Air Force Base, IL**

BROMOCHLOROMETHANE	1,4-DIFLUOROBENZENE	CHLOROBENZENE-d5
Acetone Acrolein Acrylonitrile Bromomethane Carbon disulfide Chloroethane Chloroform Chloromethane Dichlorodifluoromethane 1,1-Dichloroethane 1,2-Dichloroethane 1,2-Dichloroethane-d4* 1,1-Dichloroethene trans-1,2-Dichloroethene Iodomethane Methylene chloride Trichlorofluoromethane Vinyl chloride	Benzene Bromodichloromethane Bromoform 2-Butanone Carbon tetrachloride Chlorodibromomethane 2-Chloroethyl vinyl ether Dibromomethane 1,4-Dichloro-2-butene 1,2-Dichloropropane cis-1,3-Dichloropropene trans-1,3-Dichloropropene 1,1,1-Trichloroethane 1,1,2-Trichloroethane Trichloroethene Vinyl acetate	Bromofluorobenzene* Chlorobenzene Ethylbenzene Ethyl methacrylate 2-Hexanone 4-Methyl-2-pentanone Styrene 1,1,2,2-Tetrachloroethane Tetrachloroethene Toluene Toluene-d8* 1,2,3-Trichloropropane Xylene

\* Surrogate

TABLE 1-10

**SEMIVOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES  
ASSIGNED FOR QUANTITATION  
Scott Air Force Base, IL**

1,4-DICHLOROBENZENE-d4	NAPHTHALENE-d8	ACENAPHTHENE-d10
Aniline	Acetophenone	Acenaphthene
Benzyl alcohol	Benzoic acid	Acenaphthylene
Bis(2-chloroethyl)ether	Bis(2-chloroethoxy)methane	1-Chloronaphthalene
Bis(2-chloroisopropyl)ether	4-Chloroaniline	2-Chloronaphthalene
2-Chlorophenol	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether
1,2-Dichlorobenzene	2,4-Dichlorophenol	Dibenzofuran
1,3-Dichlorobenzene	2,6-Dichlorophenol	Diethylphthalate
1,4-Dichlorobenzene	alpha,alpha-Dimethyl-phenethylamine	Dimethylphthalate
Ethyl methanesulfonate	2,4-Dimethylphenol	2,4-Dinitrophenol
2-Fluorophenol*	Hexachlorobutadiene	2,4-Dinitrotoluene
Hexachloroethane	Isophorone	2,6-Dinitrotoluene
Methyl methanesulfonate	2-Methylnaphthalene	Fluorene
2-Methylphenol	Naphthalene	2-Fluorobiphenyl*
4-Methylphenol	Nitrobenzene	Hexachlorocyclopentadiene
N-Nitrosodimethylamine	Nitrobenzene-d8*	1-Naphthylamine
N-Nitroso-di-n-propyl-amine	2-Nitrophenol	2-Naphthylamine
Phenol	N-Nitroso-di-n-butylamine	2-Nitroaniline
Phenol-d6*	N-Nitrosopiperidine	3-Nitroaniline
2-Picoline	1,2,4-Trichlorobenzene	4-Nitroaniline
		4-Nitrophenol
		Pentachlorobenzene
		1,2,4,5-Tetrachlorobenzene
		2,3,4,6-Tetrachlorophenol
		2,4,6-Tribromophenol*
		2,4,5-Trichlorophenol
		2,4,6-Trichlorophenol

\* Surrogate



TABLE 1-10

**SEMIVOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES  
ASSIGNED FOR QUANTITATION  
Scott Air Force Base, IL**

PHENANTHRENE-d10	CHRYSENE-d12	PERYLENE-d12
4-Aminobiphenyl	Benzidine	Benzo(b)fluoranthene
Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene
4-Bromophenyl phenyl ether	Bis(2-ethylhexyl)phthalate	Benzo(g,h,i)perylene
Di-n-butylphthalate	Butylbenzylphthalate	Benzo(a)pyrene
4,6-Dinitro-2-methylphenol	Chrysene	Dibenz(a,j)acridine
Diphenylamine	3,3'-Dichlorobenzidine	Dibenz(a,h)anthracene
1,2-Diphenylhydrazine	p-Dimethylaminoazobenzene	7,12-Dimethylbenz(a)-anthracene
Fluoranthene	Pyrene	Di-n-octylphthalate
Hexachlorobenzene	Terphenyl-d14*	Indeno(1,2,3-cd)pyrene
N-Nitrosodiphenylamine		3-Methylcholanthrene
Pentachlorophenol		
Pentachloronitrobenzene		
Phenacetin		
Phenanthrene		
Pronamide		

\* Surrogate

1.8.3.3 Metals by Graphite Furnace Atomic Absorption (GFAA) - Metal analyses performed on the GFAA will follow current EPA SW 846 Methods. Instrument must be calibrated daily or once every 24 hours and each time the instrument is set-up. This includes the following calibration procedure:

1. The lamp must be peaked for position and for wavelength (the temperature of the furnace is automatically calibrated at 2600 degrees centigrade).
2. After the proper conditions for each element are programmed for furnace operation, distilled water is injected and run as a sample. This is done several times until the instrument response produces a steady base line absorbance.
3. Verify instrument is operating satisfactorily by checking the energy output of the lamp and by checking the characteristic mass on the mid-point standard, which must be  $\pm 10$  percent of the true value for that standard.
4. Calibrate instrument with four standards and a calibration blank. The calibration curve must have a correlation coefficient of greater than or equal to 0.995.
5. Verify the calibration with a 2nd source Initial Calibration Verification (ICV) standard. The observed result must be within  $\pm 10\%$  of the expected result.
6. Verify the calibration blank. The blank must be less than the instrument detection limit.
7. Verify low level standard calibration.

8. Every 10 samples, a Continuing Calibration Verification (CCV) and Continuing Calibration Blank (CCB) pair is run and must be  $\pm 10\%$  of expected value and less than three times the instrument detection limit, respectively.

1.8.3.4 Metals by Inductively Coupled Plasma (ICP) - Metal analyses on the ICP will follow current EPA SW846 method procedures. Instrument must be calibrated daily or once every 24 hours and each time instrument is set-up. This includes the following calibration procedure:

1. Verify instrument is operating satisfactorily by checking automatic gain setting and optical alignment.
2. Calibrate instrument with matrix matched mixed standards at four concentration levels and a blank. The correlation coefficient must be greater than or equal to 0.995.
3. Verify the calibration with a 2nd source Initial Calibration Verification (ICV) standard. The observed result must be  $\pm 10\%$  of the expected value.
4. Verify the calibration blank. The observed result must be less than the instrument detection limit.
5. Verify low-level standard calibration.
6. Every 10 samples, a Continuing Calibration Verification (CCV)/Continuing Calibration Blank (CCB) pair is run which must be  $\pm 10\%$  of expected value and less than the instrument detection limit, respectively.

7. Check for interferences. An interference check solution must be analyzed at the beginning and at the end of the run (or at least every eight hours); refer to EPA Methods for acceptable limits which are  $\pm 20\%$ . The interference check solution contains aluminum, calcium, iron, and magnesium.

1.8.3.5 Gravimetric Analyses - The total dissolved solids analysis falls into this category. Each analysis depends greatly on the accuracy of the balance used. For this reason, balances are calibrated weekly. The recorded weight must agree within 0.1 percent of the expected value.

1.8.3.6 Colorimetric Analysis - The cyanide ion is determined colorimetrically. The cyanide is released by refluxing the sample with strong acid and distillation of the HCN.

A minimum of five calibration standards and a blank are prepared. The correlation should not be less than 0.995. Verify the calibration with an independently prepared check standard every 15 samples. The apparent concentration of this standard must lie within 20% of the true concentration.

1.8.3.7 Cold-Vapor Atomic Absorption - Mercury is analyzed using cold-vapor atomic absorption (CVAA). An aliquot of sample is acidified and then undergoes a heated, oxidation digestion with potassium permanganate and potassium persulfate. After digestion, a solution of sodium chloride-hydroxylamine sulfate is added to the sample digestate to reduce excess permanganate and remove free chlorine. A reducing agent (stannous chloride) is then added to the solution, resulting in a reduction of the mercury to an elemental state. The elemental mercury is aerated from the

solution in a closed system and the mercury vapor content is measured as it passes through a cell positioned in the light path of an atomic absorption spectrophotometer.

Mercury analyses will follow current EPA CLP protocol. This includes the following calibration procedure:

- 1) Optimize instrument setting and alignment by maximizing the energy setting.
- 2) Align cell minimizing absorbance reading.
- 3) Check absorbance of 10 ppb standard.
- 4) Check correlation of a series of standards and calibration blanks.
- 5) Verify calibration by running an initial calibration verification standard and a calibration blank.
- 6) Analyze a CCV at the beginning of run, every 10 samples, and at the end of the run. The response must be within 20 percent of the initial response.

1.8.3.9 High Performance Liquid Chromatography (HPLC) - Explosives will be analyzed by HPLC. Aqueous samples of low concentrations are concentrated by a salting-out extraction procedure with acetonitrile and sodium chloride, diluted with reagent grade water and filtered. Aqueous samples with high concentrations are diluted 1:1 with methanol or acetonitrile and filtered. The extracts are separated on a C-18 reverse phase column determined at 254 nm and confirmed on a CN reverse phase column.

All electronic equipment is allowed to warm up for 30 minutes. During this period, at least 15 void volumes of mobile phase are passed through the column and continued until baseline is level at the UV detector's greatest sensitivity.

The initial calibration is performed by triplicate injections of five standards in random order. A linear calibration curve of response factors is calculated.

A daily calibration exists of analyzing a mid-point standard in triplicate at the beginning, the middle and after the last sample. The mean response factor must agree within 25 percent of the initial calibration.

#### 1.9 DATA REDUCTION, VALIDATION, AND REPORTING

The following section describes the reduction, validation, and reporting of data employed after samples are analyzed.

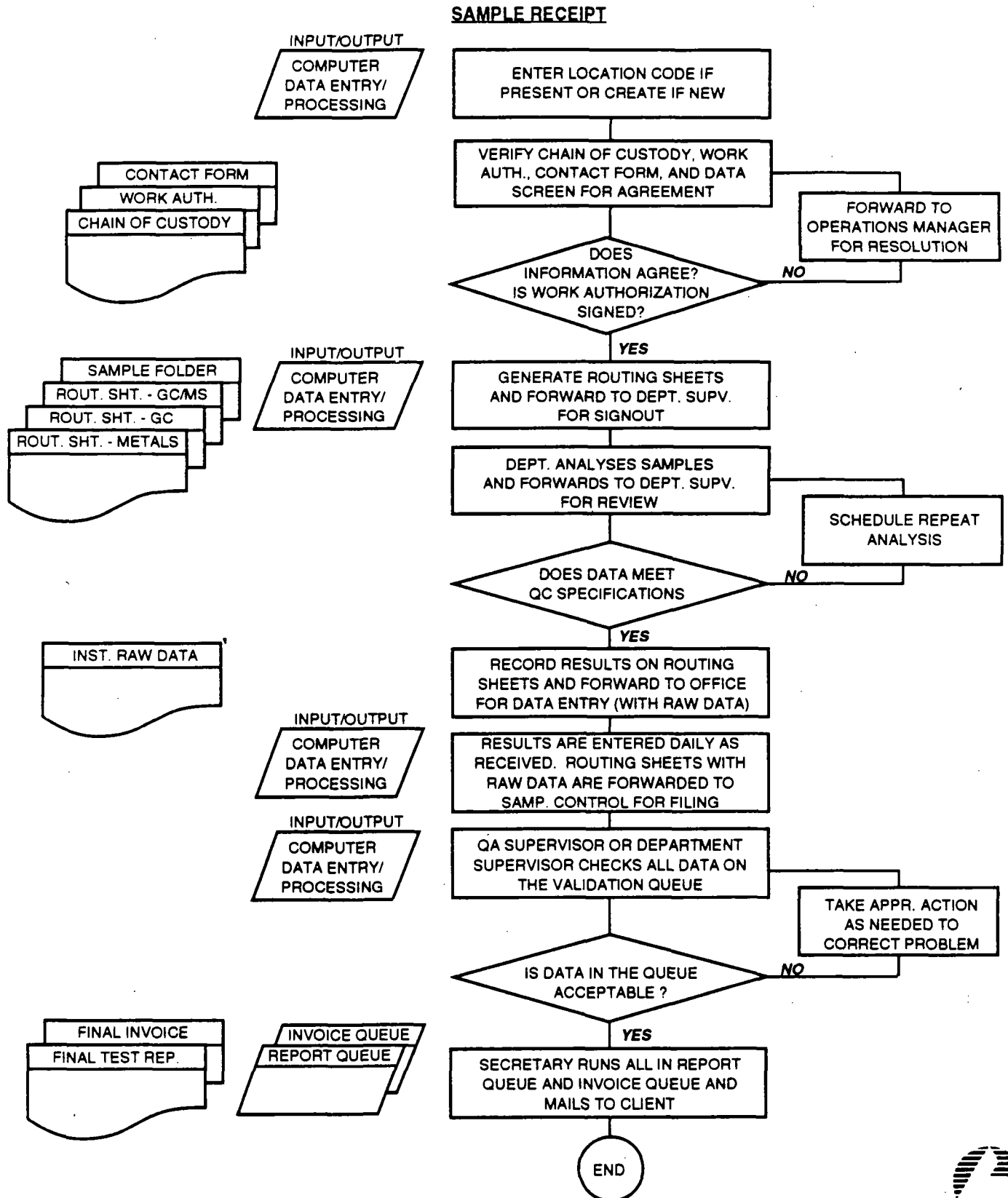
##### 1.9.1 Data Management

The following section describes how analytical data is collected and processed in the laboratory.

1.9.1.1 Data Flow - Analytical data are collected and processed in accordance with the requirements of the LENL-Pensacola Generic QA Manual. These requirements include sample documentation and data collection. Sample/data flow is outlined in Figure 1-9.

1.9.1.2 Data Collection - Data collection activities follow closely with sample documentation. For example, as a sample enters a specific lab for analysis, it is documented by intra-lab chain-

# FIGURE 1-9 LENL-PENSACOLA LABWORKS SAMPLE/DATA FLOW



NOTE: SPECIAL DELIVERABLES, IF REQUESTED ARE ALSO GENERATED AFTER VALIDATION STEP IS COMPLETED

of-custody. The sample is then extracted or otherwise prepared, and data collection begins. The following sample data are collected at LENL:

- Extraction and preparation date for samples, standards, duplicates, spikes, and blanks are entered in bound notebooks.
- Final analytical results and quality control data are dated and initialed by the analyst.
- Data calculations, percent recovery and precision data are checked by the lab supervisor who initials and dates the output.
- Results are entered into the lab computer system by direct entry or electronic transfer.

#### 1.9.2 Data Reduction

Computerized data stations are present for all analytical equipment. The majority of data reduction at Law is performed by the data station associated with that particular piece of equipment.

The analyst performs the analysis and enters the data on the parameter bench sheet and corresponding data station(s). Bench sheets contain all necessary information to establish sample identity, integrity, calibration evaluation, and analytical observation/results to process/validate the sample test data. A bench sheet key is provided to the analyst which specifies the way in which bench sheets are to be filled out (i.e., notation, significant figures, etc.), the data reduction formula and the QC samples required and their control criteria. QC samples include duplicates, matrix spikes, or matrix spike duplicates, continuing



calibration verification samples (CCVs), etc. Calculations are performed by the data station at each instrument and/or specialized software utilized by MIS Department. The use of rounding rules and significant digits for numerical data are in accordance with EPA-600/4-79-019 publication, Handbook for Analytical Quality Control in Water and Wastewater Laboratories.

#### SAMPLE QUANTITATION

Sample quantitation will be performed based on the formulae listed below. Normal laboratory soil calculations have been modified to comply with AFCEE mandates for mg/Kg results for organic analysis. All Response Factors (RF) and Calibration Factors (A<sub>s</sub>) will be determined from the initial calibration. Daily standards will be used for continuing quality control monitoring only.

#### Organic Analysis

External Standard Method:

$$\mu\text{g/L} = \frac{(A_x) (A) (V_t) (D)}{(A_s) (V_i) (V_s)}$$

$$A_s = \frac{\text{Total Area of Peak(s)} *}{\text{Mass Injected (ng)}}$$

$$\text{mg/Kg} = \frac{(A_x) (A) (V_t) (D)}{(A_s) (V_i) (W)} \times 0.0001$$

\* This formula will be used only if the %RSD for the initial calibration < or = 20. Quantitation of compounds with calibrations that do not meet this criteria will be quantitated from the calibration curve using the linear equation (with the origin through zero).

Internal Standard (IS) Method:

$$\mu\text{g/L} = \frac{(A_x) (C_{is}) (D)}{(A_{is}) (RF) (V_s)}$$

$$RF = \frac{(A_x) (T_{is})}{(A_{is}) (T_c)}$$

$$\text{mg/Kg} = \frac{(A_x) (C_{is}) (D)}{(A_{is}) (RF) (W_s)} \times 0.001$$

- A = Response for the analyte in the sample or standard being measured, units are in area count.
- A = Amount of standard injected or purged, ng.
- A = Response for the external standard, units are in area counts.
- V = Volume of extract injected, (not applicable for purge-and-trap analysis).
- D = Dilution factor or 1.
- V = Volume of total extract,  $\mu\text{L}$  (not applicable for purge-and-trap analysis).
- V = Volume of sample extracted or purged, mL.
- W = Weight of sample extracted or purged, g (Wet weight).
- W = Weight of sample extracted or purged, g  
(Dry weight)  $W_s = (W) \left( \frac{100 - \% \text{ moisture}}{100} \right)$
- C = Amount of IS added to extract or volume purged, ng.
- A = Response of the IS, units are in area counts.
- RF = Response factor of the analyte.
- T = Concentration of the IS,  $\mu\text{g/L}$ .
- T = Concentration of the analyte to be measured,  $\mu\text{g/L}$ .

## Inorganic Analysis

mg/L = Measurement taken from the calibration curve

$$\text{mg/Kg} = \text{mg/L} \times \frac{(\text{Vol}) (100)}{(\text{Wt}) (\% \text{Solids})}$$

### 1.9.3 Data Quality Assessment

Law's Project Chemist will review all data received from the laboratory. This review consists of the following:

- Sample analysis completeness - Were all samples analyzed? Were samples analyzed for the parameters listed in the SAP?
- Evaluation of Holding Times - Were samples analyzed within the specified holding and extraction times?
- Evaluation of quality control - Were standard curves within method control limits? Were preparation and method blanks contaminated? Were continuing calibration standards in control? Were matrix spikes and matrix spike duplicates performed? How did field duplicates compare?
- Establishment of detection limits - Were detection limits met? If not, why?

Law's Project Chemist utilizes "Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analysis," (EPA, 1988) as a reference to data validation.

Method-specific criteria will be used to validate any methods not presented in EPA's Laboratory Data Validation Guidelines.

If any data points are qualified, they will receive the data qualifiers described in Exhibit 5-4 of the "Risk Assessment Guidance for Superfund, Volume I (Part A)" (USEPA, 1989). If sample analysis exceeded holding times, the data would be flagged as estimated. If the method blank was contaminated with common laboratory chemicals or field contamination, any result  $\leq 10$  times that found in the blank would be flagged as estimated and resampled per AFCEE protocols. Any matrix spike (MS) and matrix spike duplicate (MSD) data would be reviewed separately and qualified based on all the data available. Estimated data are not necessarily unusable data. All project-wide precision, accuracy, and completeness goals will be reviewed and the data will be validated subject to these goals. If these goals are not met, resampling and analysis may be necessary.

The Law Project Chemist also reviews field sample data and collection. This review consists of the following:

- Field record completeness - Were all field analyses performed? Were all field samples collected? Were any problems encountered and how were they resolved? Were all field records complete?
- Sampling and decontamination procedures review - Were all field duplicates collected? How did they compare? Were all rinsates collected? Did these rinsates show contamination? Were the trip blanks contaminated? Did samples arrive intact and in proper shipping protocol?
- Identification of valid samples - Were samples collected representative? Were the wells properly constructed? Were there probable sources of potential contamination during sampling?

- Correlation of field test data and identification of anomalous field test data - Did different methods of measurements for the same test correlate?

Review of field data such as rinsates, trip blanks and duplicates can help in assessing sample integrity. The field data and laboratory data will be reviewed and evaluated to the data quality objectives established in this plan. Data validation will be performed on all Scott AFB samples (100%).

#### 1.9.4 Data Reporting

All data reports will be included in the technical reports preparation. The data will be presented as tables or in the appendices of the report. Tables will include the following information:

- sampling dates
- extraction and analysis dates
- surrogate recovery (if applicable)
- MS/MSD results
- duplicate/replicate results
- rinsate results
- positive results
- field characterization data (pH, SC, temp)
- control limits (surrogates, MS/MSD, duplicates)

#### 1.10 INTERNAL QUALITY CONTROL CHECKS

The following sections describe the quality control checks employed in the field and laboratory.

#### 1.10.1 Field Quality Control

Quality control of field measurements will be utilized through the calibration of instruments. The control parameters, control limits, and corrective actions are outlined in Section 2.4 of the Field Sampling Plan.

#### 1.10.2 Laboratory Quality Control

The minimum requirements of the laboratory quality control consist of an initial demonstration of laboratory capability and an ongoing analysis of spiked samples to evaluate and document quality data. The laboratory must maintain records to document the quality of the data generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a quality control check standard must be analyzed to confirm that the measurements were performed in an in-control mode of operation.

Before processing any samples, the analyst should demonstrate, through the analysis of a reagent water blank, that interferences from the analytical system, glassware, and reagents are under control. Each time a set of samples is extracted or there is a change in reagents, whichever is more frequent, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

For each analytical batch (up to 20 samples), a reagent blank, matrix spike and matrix spike duplicate/duplicate must be analyzed (the frequency of the spikes may be different for different monitoring programs). The blank and spiked samples must be carried through all stages of the sample preparation and measurement steps.

The experience of the analyst performing gas chromatography is invaluable to the success of the methods. Each day that analysis is performed, the daily calibration sample should be evaluated to determine if the chromatographic system is operating properly.

The laboratory must, on an ongoing basis, analyze at least one matrix spike and matrix spike duplicate/duplicate per analytical batch (maximum of 20 samples per batch) to assess accuracy. For laboratories analyzing one to ten samples per month, at least one spiked sample per month is required.

If any analyte fails the acceptance criteria for recovery, a QC check standard for each analyte that failed must be prepared and analyzed.

As part of the QC program for the laboratory, method accuracy for each matrix studied must be assessed and records must be maintained.

The laboratory should analyze standard reference materials and participate in relevant performance evaluation studies.

Types of laboratory quality control samples to be used are as follows:

Method blanks. Method blanks consist of organic-free or deionized water that is carried through the analytical scheme like a sample. They serve to measure contamination associated with laboratory storage, preparation, or instrumentation. For most analyses, a method blank is analyzed for each batch and at a frequency of 1 per 20 samples if more than 20 samples are run in a given batch. If the analyte of interest is above the reporting detection limit, corrective action should be taken except for common solvents such as methylene chloride, acetone, toluene, 2-butanone and phthalates.

Trip Blanks and Ambient Condition Blanks. Trip blanks begin as organic-free reagent water in the laboratory. A sample vial is filled with reagent water and carried with other sample containers to the field and back to the laboratory. Ambient condition blanks begin as sample vials which are carried to the sample site and filled with organic-free water at the location. Trip blanks are to be collected whenever volatile organics are being sampled. Ambient blanks will be collected when samples are collected downwind of possible volatile sources. Both blanks identify contamination associated with collection and transportation of the sample.

Sample blanks. Sample blanks are used when characteristics like color or turbidity interfere with a determination. In a spectrophotometric method, for example, the natural absorbance of the sample is measured and subtracted from the absorbance of the developed sample. Sample blanks are run only as necessary.

Calibration blanks. Calibration blanks are prepared with standards to create a calibration curve. They differ from the other standards only by the absence of analyte and provide the "zero-point" for the curve.

Internal standards. Internal standards are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an internal standard calibration method to correct sample results suffering from capillary column injection losses, purging losses, or viscosity effects. Internal standard calibration is currently used for volatile organics, chlorinated pesticides and GC/MS extractables.

Surrogates. Surrogates are measured amounts of certain compounds added before preparation or extraction of a sample. The recovery of a surrogate is measured to determine systematic extraction problems. Surrogates are added to all samples analyzed for chlorinated pesticides, GC/MS extractables and volatiles, and GC volatiles.



Spikes. Spikes are aliquots of samples to which known amounts of analyte have been added. They are subjected to the sample preparation or extraction procedure and analyzed as samples. The stock solutions used for spiking are purchased or prepared independently of calibration standards.

The spike recovery measures the effects of interferences in the sample matrix, and reflects the accuracy of the determination. Spike recoveries are calculated as follows:

Check Standard	Percent Recovery = $\frac{\text{Observed}}{\text{Expected}} \times 100$
Method Standard	
Check Sample	

Matrix Spike	Percent Recovery = $\frac{\text{SSR} - \text{SR}}{\text{SA}} \times 100$
--------------	--

Where,

SSR	=	Spike Sample Result
SR	=	Sample Result
SA	=	Spike added from Spiking Mix

Spikes are prepared and analyzed for each batch and at a frequency of at least one per 20 samples if more than 20 samples are run in a given batch.

Spike recoveries are stored in the laboratory database and are retrievable for statistical analysis. Laboratory control limits are calculated for individual matrix types when 20 data points become available.

Duplicate or Duplicate Spikes. Duplicate spikes are additional spiked aliquots of samples subjected to the same preparation and analytical scheme as the original spike sample. The relative percent difference (RPD) between duplicates or duplicate spikes measures the precision of a given analysis. RPDs are calculated as follows:

$$\%RPD = \frac{R1 - R2}{Rav} \times 100$$

or

$$\%RPD = \frac{S1 - S2}{Sav} \times 100$$

where

R1 and R2 = duplicate determinations of the analyte in the sample  
 S1 and S2 = the observed concentrations of analyte in the spike and its duplicate  
 Rav = the average determination of the analyte concentration in the original sample  
 Sav = the average of the observed analyte concentrations in the spike and its duplicate.

Duplicates or duplicate spikes are prepared and analyzed for each batch, or at a frequency of at least one per 20 samples if more than 20 samples are run in a given batch.

RPDs are stored in the laboratory database and are retrievable for statistical analysis.

Laboratory Control Standards. Laboratory control standards (LCSs and QCCSs) are aliquots of organic-free or deionized water to which known amounts of analyte have been added. They are subjected to the sample preparation or extraction procedure and analyzed as samples. The stock solutions used for LCSs are purchased or prepared independently of calibration standards. The LCS recovery tests the function of analytical methods and equipment. For inorganic and metals analyses, the percent recovery for LCSs is compared to method specific criteria, and the analytical system is

considered to be in control when these analyte specific criteria are met. When a result of an organic method aqueous matrix spike and/or matrix spike duplicate indicates atypical method performance, a quality control check standard will be analyzed to confirm that the measurements were performed in an in-control mode of operation for that analyte.

The acceptance criteria for the LCS is a recovery range of 80-120%. The acceptance criteria for the QCCS is stated in each method.

LCSs are prepared and analyzed for each batch or at a frequency of one per 20 samples if more than 20 samples are run in a given batch. Laboratory control limits are calculated when 20 data points become available.

The LCS is used to monitor overall performance of all steps in analysis, including sample preparation. If the LCS results fall within 20% of the calibration curve, this verifies that instrument performance, calibration and sample preparation are satisfactory. When the LCS is used in conjunction with matrix spikes, matrix spike recovery evaluation can be better interpreted as either matrix interference, preparatory error or matrix spiking solution preparation may be incorrect.

Specific laboratory control procedures, are as follows:

#### Volatile Organics Analyses by GC/MS

1. Surrogate compounds will be spiked into each sample, standard, and reagent water blank. The target spike concentration should be 50 µg/L. The surrogate compounds are as follows:

- toluene-d8
- 4-bromofluorobenzene
- 1,2-dichloroethane-d4

2. Internal standards will be added to each sample, standard and reagent blank. The final concentration of each internal standard will be 50  $\mu\text{g/L}$ . The internal standards are as follows:
  - Bromochloromethane
  - 1,4-Difluorobenzene
  - Chlorobenzene- $\text{d}_5$
3. At least one sample or 1 in 20 samples (whichever is more frequent) will be spiked to assess accuracy of the data. The spiking compounds are listed in Table 1-16. The target spike concentration should be 50  $\mu\text{g/L}$ .
4. At least one sample or 1 in 20 samples (whichever is more frequent) will be spike duplicated to assess precision of the data. The duplicate spike will be a replicate of Item 3 above.
5. A blank must be run each time a set of samples is extracted or there is a change in reagents.

#### Semi-Volatile Organics by GC/MS

1. Surrogate compounds will be spiked into each sample, standard, and reagent water blank. The target spike concentration should be 100  $\mu\text{g/L}$  for base/neutrals and 200  $\mu\text{g/L}$  for acids. The surrogate compounds are as follows:
  - phenol- $\text{d}_6$
  - 2-fluorobiphenyl
  - 2,4,6-tribromophenol
  - nitrobenzene- $\text{d}_5$
  - 2-fluorophenol
  - p-terphenyl- $\text{d}_{14}$

2. Internal standards will be added to each sample, standard and reagent blank. The final concentration of each internal standard will be 40 nanograms per microliter (ng/ $\mu$ L). The internal standards are as follows:
  - 1,4-Dichlorobenzene- $d_4$
  - Naphthalene- $d_8$
  - Acenaphthene- $d_{10}$
  - Phenanthrene- $d_{10}$
  - Chrysene- $d_{12}$
  - Perylene- $d_{12}$
3. At least one sample or 1 in 20 samples (whichever is more frequent) will be spiked prior to sample extraction to access accuracy of the data. The spiking compounds are listed in Table 1-16.
4. At least one sample or 1 in 20 samples (whichever is more frequent) will be spike duplicated prior to sample extraction to access precision of the data. The duplicate spike will be a replicate of Item 3 above.
5. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed.

#### Organics by GC

1. Surrogate compounds will be spiked, for EPA SW846 Method 8080, into each sample, standard, and reagent water blank. The target spike concentration should be 30  $\mu$ g/L. The surrogate compounds are dibutylchloroendate and 2,4,5,6-tetrachloro-metaxylene. Precision limits are described in EPA Method 8000 and are as follows:

- a. For each sample analyzed, calculate the percent recovery of each surrogate in the sample.
  - b. Once a minimum of 30 samples of the same matrix have been analyzed, calculate the average percent recovery (p) and standard deviation of the percent recovery (s) for each of the surrogates. The standard deviation is calculated based on "n-1" weighing.
  - c. For a given matrix, calculate the upper and lower control limit for method performance for each surrogate standard. This should be done as follows:
    - Upper Control Limit (UCL) =  $p + 3s$
    - Lower Control Limit (LCL) =  $P - 3s$
2. At least one sample or 1 in 20 samples (whichever is more frequent) will be spiked to assess accuracy of the data.
  3. At least one sample or 1 in 20 samples (whichever is more frequent) will be spike duplicated to assess precision of the data. The duplicate spike will be a replicate of Item 2 above.
  4. Samples will be within the concentration range of the standards.
  5. After an initial five-point calibration has been established, a mid-point calibration verification standard should be analyzed at the beginning of a run and after every 10 samples. The calibration verification standard must be within  $\pm 15\%$  difference of the initial response calibration.

- criteria*
6. At least one reagent water blank must be analyzed each day to demonstrate that interferences and/or contamination are not present. If a problem exists, corrective action will be taken before samples are analyzed.  
*what*
  7. A QC check sample prepared independently from the calibration standards will be analyzed at least every 20 samples.  
*criteria*

Metals by ICP

1. At least one matrix spike or 1 in 20 samples (whichever is more frequent) will be spiked prior to digestion. The spike recovery must be within  $\pm 25\%$  of the spiking value. If not, the data must be flagged with a corrective action report.
2. At least one sample or 1 in 20 samples (whichever is more frequent) will be spike duplicated prior to digestion to assess precision of the data. The duplicate spike will be a replicate of item 1 above.
3. A continuing calibration verification standard (CCV) will be analyzed at the beginning, every 10 samples, and at the end of the run. The response must be within 10 percent of the initial response; if not, recalibration of the instrument is required and those samples prior to the out-of-control CCV must be reanalyzed.
4. A continuing calibration blank (CCB) will be analyzed at the beginning, every 10 samples, and at the end of the run. The response must be  $\pm$ CRDL; if not, recalibration is required and those samples prior to the out-of-control CCB must be reanalyzed.

5. An interference check solution must be analyzed at the beginning and at the end of the run (or at least every 8 hours); refer to EPA Methods for acceptable limits which are  $\pm 20\%$ .

#### Metals by Graphite Furnace AA

1. At least one matrix spike or 1 in 20 samples (whichever is more frequent) will be spiked prior to digestion. The spike recovery must be within  $\pm 25\%$  of the spiking value. If the recovery is out of range, the data will be flagged.
2. A post-digestion spike (analytical spike) must be performed on every sample with a recovery of  $\pm 15\%$  of the original sample concentration. Analytical spikes are considered as a sample.
3. At least one sample or 1 in 20 samples (whichever is more frequent) will be spike duplicated prior to digestion to assess precision of the data. The duplicate spike will be a replicate of item 1 above.
4. An initial calibration verification (ICV) will be analyzed immediately after the initial calibration, after every 10 samples (CCV) and at the end of the run. The response must be within  $\pm 10\%$  of the true value; if not, recalibration is required and any samples run prior to the out-of-control CCV must be reanalyzed. ICV/CCV standard solutions must be supplied by an EPA-approved second source.
5. A continuing calibration blank (CCB) will be analyzed at the beginning, every 10 samples, and at the end of the run. The response must be less than the CRDL; if not,



recalibration is required and those samples assayed prior to the out-of-control CCB must be reanalyzed.

6. At least one reagent blank must be prepared and analyzed with each digestion lot or every 20 samples received, whichever is more frequent.

#### TDS

1. The balance must be checked daily. The value must be within 0.1 percent of the expected value.
2. At least one sample or 1 in 20 samples (whichever is more frequent) will be duplicated to assess precision of the data.
3. At least one reagent blank or 1 in 20 samples (whichever is more frequent) must be analyzed to demonstrate that interference and/or contaminants are not present.

#### Cyanide

1. A calibration curve will be analyzed for each batch. The correlation coefficient must be  $>0.995$ .
2. At least one matrix spike or 1 in 20 samples (whichever is more frequent) will be spiked prior to digestion. The spike recovery must be within  $\pm 25\%$  of the spiking value. If the recovery is out of range, the data will be flagged.
3. At least one sample or 1 in 20 samples (whichever is more frequent) will be spike duplicated prior to digestion to assess precision of the data. The duplicate spike will be a replicate of item 2 above.

4. At least one reagent blank must be prepared and analyzed with each digestion lot or every 20 samples received, whichever is more frequent.

#### 1.10.3 Control Limits

Control limits for this project are method specific and laboratory established. Project wide control limits expressed as precision, accuracy, and completeness can be found in Section 1.4. Table 1-11 presents the control limits for each analytical method including frequency, acceptance criteria, and corrective action.

#### 1.11 PERFORMANCE AND SYSTEM AUDITS

Law views quality assurance as the means by which the effectiveness and quality of its various participating departments are gauged as they carry on day-to-day operations under the QA/QC program. The major goals associated with the QA/QC program are listed below:

- QA reviews should help ensure compliance with mandated QC procedures;
- QA reviews provide a structured means of communicating problems between the technical and administrative portions of the company;
- QA procedures are designed to ensure operating regularity between the various branches of Law; and
- QA audits provide a mechanism by which our QC procedures are constantly being reviewed and updated in an orderly fashion.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 120.1	Specific Conductance	<u>INSTRUMENT QC:</u>			
		Calibration	Prior to trip	$\pm 25$ umhos/cm	1. Check system as per manufacturer's instructions. 2. Check standard. 3. Replace instrument.
		Calibration Stability	At beginning and end of day	$\pm 25$ umhos/cm	1. Check standard. 2. Check system as per manufacturer's instructions. 3. Replace instrument.
		<u>SAMPLE QC:</u>			
		Duplicate	1 per day	$\pm 50$ unite	1. Analyze 3rd aliquot of sample. 2. Flag Data.
		Rinsate	1 per day	$\leq$ detection limit	Flag Data.

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TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 150.1	pH	<u>INSTRUMENT QC:</u>			
		Calibration	1 per day at two levels	$\pm 0.1$ units	1. Check system as per manufacturer's instructions. 2. Check standard. 3. Replace instrument.
		Calibration Stability	1 per hour at two levels	$\pm 0.2$ units	1. Check standard. 2. Check system. 3. Recalibrate.
		<u>SAMPLE QC:</u>			
		Duplicate	1 per day	$\pm 0.5$ units	1. Analyze 3rd aliquot of sample 2. Flag data.
		Rinsate	1 per day	$\leq$ detection limit	Flag data.

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TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 170.1	Temperature	<u>INSTRUMENT QC:</u>			
		Calibration	Prior to trip	$\pm 2^{\circ}\text{C}$	1. Check against precision thermometer certified by NIST. 2. Replace instrument.
		<u>SAMPLE QC:</u>			
		Duplicate	1 per day	$\pm 2^{\circ}\text{C}$	1. Analyze 3rd aliquot of sample. 2. Flag Data.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 160.1	Total Dissolved Solids	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	% RPD $\leq$ 35%	Review lab QC data to determine if they are in control. If not, qualify data. Use data to evaluate proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Calibration of the instrument	Calibration is performed using "S" class weights. The reading of the balance is adjusted to match that of the weight.	All measures must be accurate.	Check balance maintenance, qualify data.
		Method Blank	1 per batch of 20 samples	Less than reported detection limits	Reanalyze all samples greater than MDL but less than 10x blank concentration.
		Duplicates	1 per batch of 20 samples	RPD $\leq$ 20%	Qualify data.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)		PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846	7060	Total Arsenic	<u>FIELD QC:</u>			
	7421	Total Lead	Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	7471	Total Mercury				
	7740	Total Selenium				
	7841	Total Thallium				
			Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
			<u>LABORATORY QC:</u>			
			ICV/CCV	ICV - prior to analysis CCV - after every 10 samples and end of analytical batch	5 pt. calibration; Measured value within 10% of true value (20% for Hg)	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
			ICB/CCB	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value < MDL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
			Prep Blank	1 per batch of samples, minimum of 1 per 20 samples	Absolute value < MDL	Redigest and reanalyze all samples less than 10X the MDL.
			MS/MSD	1 per batch of samples, minimum of 1 per 20 samples	See Table 1-16 for current control limits.	Perform post digest spike and qualify all associated data.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)		PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
<b>SW846</b> Inductively Coupled Argon Plasma (ICAP)	<b>6010</b>	Total Metals	<u>FIELD QC:</u>			
			Duplicate	1 for every 10 field samples collected	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
			Rinsate (c)	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Qualify data.
			<u>LABORATORY QC:</u>			
			Initial (ICV) and Continuing (CCV) Calibration Verification	ICV - prior to sample analysis CCV - after every 10 samples and end of analytical batch	4 pt. calibration; Measured value within 10% of true value	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
			Initial (ICB) and Continuing (CCB) Calibration Blank	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value $\leq$ Method Detection Limit (MDL)	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
			Prep Blank	1 per batch of samples, minimum 1 per 20 samples	Absolute value $\leq$ Method Detection Limit (MDL)	Redigest and reanalyze all samples greater than the MDL but less than 10x the blank concentration.
			MS/MSD	1 per batch of samples, minimum 1 per 20 samples	See Table 1-16 for current control limits.	Perform a post-digestion spike and qualify data appropriately.
			Laboratory Control Sample (LCS)	1 per batch of samples, minimum 1 per 20 samples	80 - 120% recovery: waters 75 - 125% recovery: sol/seed.	Rerun. If still out of control, solve problem and reanalyze batch.
			Interference Check	Beginning and end of run or per 8 hour shift	80-120% recovery	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good ICS.

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TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)		PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846	9010	Cyanide	<u>FIELD QC:</u>			
			Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
			Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
			<u>LABORATORY QC:</u>			
			ICV/CCV	ICV - prior to sample analysis CCV - after every 10 samples and end of analytical batch	4 pt. calibration; Measured value within 15% of true value	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
			ICB/CCB	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value $\leq$ MDL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
			Prep Blank	1 per batch of samples, minimum 1 per 20 samples	Absolute value $\leq$ MDL	Redigest and reanalyze all samples greater than the MDL but less than 10x the blank concentration.
			MS/MSD	1 per batch of samples, minimum 1 per 20 samples	See Table 1-16 for current control limits.	Perform a post-digestion spike and qualify data appropriately.
			LCS	1 per batch of samples, minimum 1 per 20 samples	80-120% recovery: waters  75-125% recovery: soil/seed.	Rerun. If still out of control, solve problem and reanalyze batch.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK		FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846	8080	Pesticides/PCBs	<u>FIELD QC:</u>			
			Duplicate	1 for every 10 field samples collected 5% (wipe samples)	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
			Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limit	Qualify data.
			Field Blanks	(wipe samples only) 2 from each category	Less than reported detection limit	Qualify data.
			<u>LABORATORY QC:</u>			
			Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; CCCs response factor deviates < 20% from average	Recalibrate instrument.
			Continuing Calibration	Daily and after every 10 samples	CCCs response factor deviates < 15% from average of initial calibration	Rerun continuing calibration. If still out of control, recalibrate instrument.
			Endrin and DDT Breakdown	Daily	Must not exceed 20%	Reanalyze breakdown standard. If still out of control, clean injection port, change septae, replace first few inches of packing in column.
			Method Blank	1 for every 20 samples, or every day	Less than reporting detection limit	Reanalyze blank. If second blank exceeds criteria, clean analytical system. Qualify the data.
			Surrogate Recovery	Every sample	See Table 1-16 for current control limits	Rerun sample. If still out of control, re-extract, reanalyze, qualify data.
			MS/MSD	1 for every 20 samples	See Table 1-16 for current control limits	Rerun sample. If still out of control, qualify data.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)		PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846	8240	Volatile Organic Compounds	<u>FIELD QC:</u>			
			Trip Blank	1 for each batch of samples shipped to laboratory	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
			Ambient Blank	Collected when samples are collected downwind of possible volatile sources.	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
			Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
			Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
			<u>LABORATORY QC:</u>			
			Sensitivity Check with BFB	Every 12 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
			Mass Calibration	Every 12 hours of operation	See Method SW846	Tune instrument; repeat.
			Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; SPCCs exceed 0.300; CCCs response factor deviates < 30% from average	Recalibrate instrument.
			Continuing Calibration	Every 12 hours of operation	SPCCs exceed 0.300 with the exception of bromoform which must exceed 0.250; CCCs response factor deviates < 25% from average of initial calibration	Rerun continuing calibration. If still out of control, recalibrate instrument.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)		PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846	8240		Method Blank	1 for every 20 samples, or every day	Less than reporting detection limit	Reanalyze blank. If contamination still exists, qualify results < 10 times that found in the blank (for blanks contaminated with common laboratory chemicals) and qualify all results < 5 times that found in the blank (for blanks contaminated with compounds not commonly found in the laboratory)
			Surrogate Recovery	Every sample	See Table 1-16 for current control limits	Reanalyze sample; flag data.
			MS/MSD	1 for every 20 samples	See Table 1-16 for current control limits	Reanalyze samples. If still out of control, qualify the data.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 GC/MS	8270 Base/Neutral/ Acid Extractable Organics	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reporting limit	Qualify data.
		<u>LABORATORY QC:</u>			
		Sensitivity Check with DFTPP	Every 12 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
		Mass Calibration	Every 12 hours of operation	See Method SW846	Tune instrument; repeat.
		Initial Calibration	Before analysis and when continuing calibration fails criteria	5 pt. calibration; SPCCs exceed 0.050; CCCs response factor deviates < 30% from average	Recalibrate instrument.
		Continuing Calibration	Every 12 hours of operation	SPCCs exceed 0.050; CCCs response factor deviates < 25% from average of initial calibration	Rerun continuing calibration; if still out of control, recalibrate instrument.
		Method Blank	1 for every 20 samples	Less than reporting detect limit	Reanalyze blank, then re-extract, qualify all results < 10 times that found in blank (for blanks contaminated with common laboratory chemicals) and qualify all results < 5 times that found in blank (for blanks contaminated with compounds not commonly found in the laboratory)
		Surrogate Recovery	Every sample	See Table 1-16 for current control limits	Rerun sample. If still out of control, re-extract, reanalyze, qualify data.
		MS/MSD	1 for every 20 samples	See Table 1-16 for current control limits	Rerun sample. If still out of control, qualify data.

TABLE 1-11

**SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA**  
**Scott Air Force Base, Illinois**

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK		FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846	8330	Explosives	<u>FIELD QC:</u>			
			Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
			Rinsate (c)	1 for every 10 field samples collected	Less than reporting limit	Qualify data.
			<u>LABORATORY QC:</u>			
			Initial Calibration	Before analysis and when continuing calibration fails criteria	5 pt. calibration, each pt. in triplicate	Recalibrate instrument.
			Continuing Calibration	Beginning of day, midpoint of sample run, end of day	Peak heights deviate <20% from initial calibration	Rerun continuing calibration; if still out of control, recalibrate instrument.
			Method Blank	1 for every 20 samples	Less than reporting detect limit	Reanalyze blank, then re-extract, qualify all associated data.
			MS/MSD	1 for every 20 samples	See Table 1-16 for current control limits	Rerun sample. If still out of control, qualify data.

#### 1.11.1 Systems Audits

Systems audits are qualitative evaluations of all components of field and laboratory QC measurement systems. A systems audit will be performed periodically and will consist of inspecting the following procedures:

- Sampling
- Sample custody
- Sample storage and preservation
- Sample preparation
- Analytical methodology
- Data management
- Preventative maintenance
- Personnel qualifications

Law has participated in systems audits from federal and state agencies, including on-site inspection by Department of Environmental Regulation (DER) and AFCEE. Law will submit to on-site external systems audits by DER and AFCEE.

#### 1.11.2 Performance Audits

*No programs*

A performance audit is a quantitative evaluation of a measurement system. Law participates in the following performance evaluation programs:

- EPA, Environmental Monitoring Support Laboratory - Cincinnati
- Florida Department of Environmental Regulation (DER)
- EPA Inorganic and Organic CLP
- U.S. Army Corps of Engineers, Missouri River Division
- Florida Department of Health and Rehabilitative Services (FDHRS)

**TABLE 1-12**  
**ROUTINE MAINTENANCE SCHEDULE FOR GC**  
**Scott Air Force Base, IL**

Maintenance	Frequency
1. Check carrier gas supply	Daily
2. Check head pressure	Daily
3. Change septums	As needed
4. Change carrier gas filters	As needed
5. Check baseline and detector response at highest sensitivity	Quarterly
6. Air dust electronics and main frame	Annually



**TABLE 1-13**  
**ROUTINE MAINTENANCE SCHEDULE FOR GC/MS**  
**Scott Air Force Base, IL**

Maintenance	Frequency
1. <u>System Diagnostics</u>	
a. Scan box I/O test	Daily
b. Scan box DMA test	Daily
c. MS I/O test	Daily
d. Filament test	Daily
e. RF power test	Daily
f. Electromultiplier test	Daily
g. Background signal noise test	Daily
2. <u>Vacuum/Carrier Flow Check</u>	
a. Column headpressure check	Daily
b. Vacuum check	Daily
c. Replace septum	As needed
d. Leak check and tighten fittings	As needed
3. <u>Instrument Tune Check</u>	
a. BFB/DFTPP tune check	Daily
b. PFTBA tuning	As needed
4. <u>Calibration Check</u>	
a. VOA standards check	Daily
b. BNA standards check	Daily
Replace inlet liner	As needed
5. Clean source	As needed
6. Clean quadrupole rods	As needed
7. Replace column (or remove front end)	As needed

**TABLE 1-14**

**ROUTINE MAINTENANCE SCHEDULE FOR ICP  
Scott Air Force Base, IL**

MAINTENANCE	FREQUENCY
1. Check Argon pressure at tank and at nebulizer.	Daily
2. Inspect cooling water supply.	Daily
3. Inspect vacuum pump.	Daily
a. Oil level	
b. Vacuum monochromator gauge	
4. Inspect peristaltic pump windings and capillary tubing.	Daily
5. Check ICP ignition sequence.	Daily
a. Argon to torch	
b. Preignition discharge	
c. Ignition	
6. Disassemble and clean ICP nebulizer, spray chamber and torch assembly.	Weekly
7. Check peak resolution and monochromator stability using profile routines and internal Hg lamp.	Weekly
8. Change pump windings and all capillary tubing to nebulizer.	Monthly
9. Change vacuum pump oil.	Monthly

**TABLE 1-15**

**ROUTINE MAINTENANCE SCHEDULE FOR AA SPECTROPHOTOMETER  
Scott Air Force Base, IL**

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Maintenance	
<hr/>	
1.	Contact cylinders, tube, and platform should be cleaned and checked each day before running samples. Use cotton swab and methanol for cleaning.
2.	Contact cylinders should be checked for cracks and pitting. Tubes should be checked for pitting, peeling pyrolytic coating and burn marks around sample port hole. Any of the above indicate a worn tube or cylinder.
3.	Furnace/spectrometer windows should be checked and cleaned daily.
4.	Check coolant level in recirculator and temperature setting daily.
5.	Spectroscopy lab should be wet mopped, counters dusted, and exterior of instruments cleaned on a weekly basis to ensure a dust-free environment.
6.	Consult instrument operations manual for further maintenance instructions.
7.	All maintenance is to be recorded in the Maintenance Log Book.
8.	Argon gas pressure to furnace should be 60 psi. Check regulator to ensure proper pressure.

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**TABLE 1-15a**

**ROUTINE MAINTENANCE SCHEDULE FOR HPLC  
Scott Air Force Base, IL**

- 
1. Keep solvent reservoirs filled above the level of the intake frit at all times to avoid drawing air into the solvent delivery system.
  2. Purge solvents with zero grade helium while in the reservoir before use.
  3. Keep a blanket of helium over the solvents during use.
  4. Regenerate or replace columns when contamination due to retained materials or degradation of the chromatograph approaches an unacceptable level. Signs of contamination include poorly shaped peaks, poor resolution and grossly tailing peaks, an elevated baseline toward the end of the solvent gradient and/or unsatisfactory quality assurance results.

First, flush or change the guard column. If this does not improve chromatographic quality, the analytical column may be at fault.

If the analytical column shows signs of contamination, regenerate it with a series of solvent wastes. Flush or backflush the column overnight with warm (40-50°C) acetonitrile. Recommended overnight flow rates for narrow bore columns are 0.2 mL/min and for wide bore 1.0 mL/min.

Severe shoulders and/or peak splitting may indicate a column defect. Temporarily turning the column around backwards, in addition to flushing and/or backflushing, may relieve the symptoms. Replace the column if needed.

Perform the diode array detector (DAD) test regularly. If the lamp count is less than 3000 counts, a new lamp should be considered soon. Replacement is not required as long as the lamp continues to ignite and the signal to noise ratio is acceptable for the analysis in use. If the wavelength switch deviates by 3 or more from the theoretical value, adjust the switch (located under the instrument cover to the right of the DAD) until the two agree.

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**TABLE 1-15b**

**ROUTINE MAINTENANCE SCHEDULE FOR IR SPECTROPHOTOMETER**  
**Scott Air Force Base, IL**

MAINTENANCE	FREQUENCY
1. Check air filter.	Depends on use
2. Remove cuvette from sample compartment.	Daily
3. Keep instrument clean from spills.	Daily

accepted reference or true value. To determine the accuracy of an analytical method, a sample spiking program will be conducted. The results of sample spiking will be used to calculate the quality control parameter for accuracy evaluation, the Percent Recovery (%R). The Percent Recovery is defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike with that result being multiplied by one hundred.

$$\%R = \frac{X - T}{K} \times 100$$

where     X = Analytical result from the spiked sample  
          T = Analytical result from the unspiked aliquot  
          K = Known value of the spike  
          %R = Percent Recovery

To determine accuracy, surrogate, spikes, and internal standards 1 will be analyzed. The control limits will be based on a population of 20% recovery values. The control limits are calculated by determining the mean % recovery 3 times the standard deviation for the upper limit and zero as the lower.

Precision - Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of standard deviation or Relative Percent Difference (RPD) Precision is inferred through the use of duplicate samples. RPD for each component is calculated using the following equation:

$$RPD = \frac{A - B}{(A + B)/2} \times 100$$

where:    A   =   Replicate Value 1  
          B   =   Replicate Value 2  
          RPD  =   Relative Percent Difference

The calculated Percent Recovery and RPD will be summarized. The RPD data will be used to evaluate the long term precision of the analytical method.

To determine precision, duplicates and spiked duplicates will be analyzed. The control limits will be based on a population of 20 RPD values. The control limits are calculated by determining the mean RPD 3 times the standard deviation for the upper limit and zero as the lower.

Completeness - Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct or normal conditions. The result is expressed as a percentage.

$$\text{Percent completeness} = \frac{\text{Number of valid measurements}}{\text{Total number of measurements}} \times 100$$

The percent completeness for this project is 90%.

#### 1.13.2 Control Limits

Control limits for analytical methods are presented in Table 1-16. Control limits are developed by the laboratory based on historical data. If historical data are not complete then control limits are set based on those established by the method.

TABLE 1-16  
CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, AND SURROGATE SPIKES  
SCOTT AFB, ILLINOIS

ANALYTICAL METHOD	SPIKING COMPOUND	SPIKE CONCENTRATION <sup>a</sup>			CONTROL LIMITS			
		WATER (µg/L)	SOIL/SEDIMENTS (mg/kg)		PERCENT RECOVERY (%)		RELATIVE PERCENT DIFFERENCE (%)	
			Low	Medium	WATER	SOIL/SEDIMENTS	WATER	SOIL/SEDIMENTS
SW846 6010	<b>MATRIX SPIKE COMPOUND:</b>							
	Aluminum	2000	*	--	77-123	75-125 **	20	20
	Antimony	500	50	--	78-121	78-117	15	18
	Arsenic	2000	200	--	78-122	75-123	17	19
	Barium	2000	200	--	75-124	85-121	20	20
	Beryllium	50	5	--	76-124	80-116	16	20
	Cadmium	50	5	--	80-122	87-123	18	20
	Calcium	*	*	--	75-125 **	75-125 **	20	20
	Chromium	200	20	--	76-121	82-124	15	18
	Cobalt	500	50	--	75-123	88-124	14	17
	Copper	250	25	--	76-124	89-125	18	20
	Iron	1000	*	--	81-121	75-125 **	20	20
	Lead	500	50	--	77-122	86-125	17	18
	Magnesium	*	*	--	75-125 **	75-125 **	20	20
	Manganese	500	50	--	78-125	88-124	17	20
	Molybdenum	500	50	--	75-123	75-125 **	16	20
	Nickel	500	50	--	75-123	85-125	18	19
	Potassium	*	*	--	75-125 **	75-125 **	20	20
	Selenium	2000	200	--	76-124	76-124	17	20
	Silver	50	5	--	75-123	80-125	17	18
	Sodium	*	*	--	75-125 **	75-125 **	20	20
	Thallium	2000	200	--	75-123	76-121	17	20
	Vanadium	500	50	--	77-125	81-123	18	19
	Zinc	500	50	--	78-125	80-122	16	20
SW846 7060	Arsenic	40	4	--	75-118	75-125 **	18	20
SW846 7421	Lead	20	2	--	75-123	75-125 **	16	20
SW846 7740	Selenium	10	1	--	79-125	75-125 **	18	20
SW846 7841	Thallium	50	5	--	75-125 **	75-125 **	20	20
SW846 7470/ 7471	Mercury	1	0.1	--	78-123	79-123	19	18
SW846 8270	<b>MATRIX SPIKE COMPOUND (acids):</b>							
	Benzoic acid	50	1.65	50	D-500	D-500	40	40
	4-Chloro-3-methylphenol	50	1.65	50	25-144	D-175	40	40
	2-Chlorophenol	50	1.65	50	23-128	8-149	40	40

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TABLE 1-16  
CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, AND SURROGATE SPIKES  
SCOTT AFB, ILLINOIS

ANALYTICAL METHOD	SPIKING COMPOUND	SPIKE CONCENTRATION <sup>a</sup>			CONTROL LIMITS			
		WATER (µg/L)	SOIL/SEDIMENTS (mg/kg)		PERCENT RECOVERY (%)		RELATIVE PERCENT DIFFERENCE (%)	
			Low	Medium	WATER	SOIL/SEDIMENTS	WATER	SOIL/SEDIMENTS
SW846 8270	2,4-Dichlorophenol	50	1.65	50	40-124	18-173	40	40
	2,4-Dimethylphenol	50	1.65	50	38-126	4-156	40	40
	4,6-Dinitro-2-methylphenol	50	1.65	50	D-166	D-224	40	40
	2,4-Dinitrophenol	50	1.65	50	D-190	D-261	40	40
	2-Methylphenol	50	1.65	50	22-147	22-147	40	40
	4-Methylphenol	50	1.65	50	22-147	22-147	40	40
	2-Nitrophenol	50	1.65	50	10-181	D-220	40	40
	4-Nitrophenol	50	1.65	50	D-128	D-185	40	40
	Pentachlorophenol	50	1.65	50	10-171	D-225	40	40
	Phenol	50	1.65	50	11-83	D-127	40	40
	2,4,5-Trichlorophenol	50	1.65	50	D-250	D-250	40	40
	2,4,6-Trichlorophenol	50	1.65	50	41-142	5-175	40	40
	<b>MATRIX SPIKE COMPOUND (base/neutral):</b>							
	Acenaphthene	50	1.65	50	56-135	26-166	40	40
	Acenaphthylene	50	1.65	50	40-137	18-163	40	40
	Anthracene	50	1.65	50	40-131	7-156	40	40
	Benzo(a)anthracene	50	1.65	50	36-133	9-165	40	40
	Benzo(b)fluoranthene	50	1.65	50	31-148	D-196	40	40
	Benzo(k)fluoranthene	50	1.65	50	17-149	D-181	40	40
	Benzo(ghi)perylene	50	1.65	50	8-187	D-241	40	40
	Benzo(a)pyrene	50	1.65	50	18-148	D-187	40	40
	Benzyl alcohol	50	1.65	50	D-250	D-250	40	40
	bis(2-Chloroethoxy)methane	50	1.65	50	34-163	6-197	40	40
	bis(2-Chloroethyl)ether	50	1.65	50	19-147	7-169	40	40
	bis(2-Chloroisopropyl)ether	50	1.65	50	42-154	1-196	40	40
	bis(2-Ethylhexyl)phthalate	50	1.65	50	15-149	D-202	40	40
	4-Bromophenyl phenyl ether	50	1.65	50	55-116	3-181	40	40
	Butylbenzylphthalate	50	1.65	50	52-124	25-151	40	40
	4-Chloroaniline	50	1.65	50	D-250	D-250	40	40
	2-Chloronaphthalene	50	1.65	50	63-112	38-140	40	40
	4-Chlorophenyl phenyl ether	50	1.65	50	34-144	3-181	40	40
	Chrysene	50	1.65	50	23-153	D-194	40	40
	Dibenzo(a,h)anthracene	50	1.65	50	6-194	D-263	40	40

TABLE 1-16  
CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, AND SURROGATE SPIKES  
SCOTT AFB, ILLINOIS

ANALYTICAL METHOD	SPIKING COMPOUND	SPIKE CONCENTRATION <sup>a</sup>			CONTROL LIMITS			
		WATER (µg/L)	SOIL/SEDIMENTS (mg/kg)		PERCENT RECOVERY (%)		RELATIVE PERCENT DIFFERENCE (%)	
			Low	Medium	WATER	SOIL/SEDIMENTS	WATER	SOIL/SEDIMENTS
SW846 8270	Dibenzofuran	50	1.65	50	D-250	D-250	40	40
	Di-n-butylphthalate	50	1.65	50	16-116	D-157	40	40
	1,2-Dichlorobenzene	50	1.65	50	34-125	16-145	40	40
	1,3-Dichlorobenzene	50	1.65	50	5-160	D-188	40	40
	1,4-Dichlorobenzene	50	1.65	50	21-112	1-139	40	40
	3,3'-Dichlorobenzidine	50	1.65	50	14-213	D-279	40	40
	Diethylphthalate	50	1.65	50	14-97	D-127	40	40
	Dimethylphthalate	50	1.65	50	D-112	D-136	40	40
	2,4-Dinitrotoluene	50	1.65	50	35-124	3-165	40	40
	2,6-Dinitrotoluene	50	1.65	50	55-143	15-182	40	40
	Di-n-octylphthalate	50	1.65	50	3-143	D-177	40	40
	Fluoranthene	50	1.65	50	30-130	D-176	40	40
	Fluorene	50	1.65	50	59-119	31-149	40	40
	Hexachlorobenzene	50	1.65	50	6-144	D-182	40	40
	Hexachlorobutadiene	50	1.65	50	24-111	D-139	40	40
	Hexachlorocyclopentadiene	50	1.65	50	7-86	D-111	40	40
	Hexachloroethane	50	1.65	50	41-100	23-140	40	40
	Indeno[1,2,3-cd]pyrene	50	1.65	50	2-140	D-190	40	40
	Isophorone	50	1.65	50	26-196	1-230	40	40
	2-Methylnaphthalene	50	1.65	50	D-250	D-250	40	40
	Naphthalene	50	1.65	50	32-123	4-155	40	40
	2-Nitroaniline	50	1.65	50	D-250	D-250	40	40
	3-Nitroaniline	50	1.65	50	D-500	D-500	40	40
	4-Nitroaniline	50	1.65	50	D-500	D-500	40	40
	Nitrobenzene	50	1.65	50	42-160	4-200	40	40
	n-Nitrosodiphenylamine	50	1.65	50	13-143	D-180	40	40
	n-Nitrosodipropylamine	50	1.65	50	9-171	D-236	40	40
	Phenanthrene	50	1.65	50	55-113	30-154	40	40
	Pyrene	50	1.65	50	60-113	25-143	40	40
	1,2,4-Trichlorobenzene	50	1.65	50	46-140	25-184	40	40
	<b>SURROGATE (acids):</b>							
	2-Fluorophenol	100	3.3	100	25-99	26-119	NA	NA
	Phenol-d6	100	3.3	100	17-93	29-113	NA	NA
	2,4,6-Tribromophenol	100	3.3	100	16-118	19-118	NA	NA

**TABLE 1-16**  
**CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, AND SURROGATE SPIKES**  
**SCOTT AFB, ILLINOIS**

ANALYTICAL METHOD	SPIKING COMPOUND	SPIKE CONCENTRATION <sup>a</sup>			CONTROL LIMITS			
		WATER (µg/L)	SOIL/SEDIMENTS (mg/kg)		PERCENT RECOVERY (%)		RELATIVE PERCENT DIFFERENCE (%)	
			Low	Medium	WATER	SOIL/SEDIMENTS	WATER	SOIL/SEDIMENTS
SW846 8270	<b>SURROGATE (base/neutrals):</b>							
	Nitrobenzene-d5	50	1.65	50	39-104	27-119	NA	NA
	2-Fluorobiphenyl	50	1.65	50	46-110	33-113	NA	NA
	Terphenyl-d14	50	1.65	50	38-137	25-135	NA	NA
SW846 8240	<b>MATRIX SPIKE COMPOUND:</b>							
	Acetone	50	0.05	6.25	32-199	D-208	40	40
	Benzene	50	0.05	6.25	46-147	32-171	40	40
	Bromodichloromethane	50	0.05	6.25	49-150	16-198	40	40
	Bromoform	50	0.05	6.25	66-163	30-186	40	40
	Bromomethane	50	0.05	6.25	28-156	9-213	40	40
	2-Butanone (MEK)	50	0.05	6.25	29-156	D-213	40	40
	Carbon disulfide	50	0.05	6.25	21-184	D-222	40	40
	Carbon tetrachloride	50	0.05	6.25	78-132	34-161	40	40
	Chlorobenzene	50	0.05	6.25	49-152	20-186	40	40
	Chloroethane	50	0.05	6.25	35-177	19-208	40	40
	2-Chloroethyl vinyl ether	50	0.05	6.25	9-244	D-278	40	40
	Chloroform	50	0.05	6.25	56-126	27-152	40	40
	Chloromethane	50	0.05	6.25	32-162	18-201	40	40
	Dibromochloromethane	50	0.05	6.25	60-143	30-179	40	40
	1,1-Dichloroethane	50	0.05	6.25	68-139	37-162	40	40
	1,2-Dichloroethane	50	0.05	6.25	29-153	25-192	40	40
	1,1-Dichloroethene	50	0.05	6.25	32-192	7-229	40	40
	trans-1,2-Dichloroethene	50	0.05	6.25	81-119	51-143	40	40
	1,2-Dichloropropane	50	0.05	6.25	12-192	2-225	40	40
	cis-1,3-Dichloropropene	50	0.05	6.25	19-194	8-233	40	40
	trans-1,3-Dichloropropene	50	0.05	6.25	19-177	1-206	40	40
	Ethylbenzene	50	0.05	6.25	47-155	24-192	40	40
	2-Hexanone	50	0.05	6.25	17-191	D-229	40	40
	Methylene chloride	50	0.05	6.25	8-173	D-192	40	40
	4-Methyl-2-pentanone (MIBK)	50	0.05	6.25	19-186	D-226	40	40
	Styrene	50	0.05	6.25	27-178	6-196	40	40
	1,1,2,2-Tetrachloroethane	50	0.05	6.25	49-140	24-179	40	40
	Tetrachloroethene	50	0.05	6.25	71-142	38-175	40	40
	Toluene	50	0.05	6.25	60-144	18-177	40	40

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TABLE 1-16  
CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, AND SURROGATE SPIKES  
SCOTT AFB, ILLINOIS

ANALYTICAL METHOD	SPIKING COMPOUND	SPIKE CONCENTRATION <sup>a</sup>			CONTROL LIMITS			
		WATER (µg/L)	SOIL/SEDIMENTS (mg/kg)		PERCENT RECOVERY (%)		RELATIVE PERCENT DIFFERENCE (%)	
			Low	Medium	WATER	SOIL/SEDIMENTS	WATER	SOIL/SEDIMENTS
SW846 8240	1,1,1-Trichloroethane	50	0.05	6.25	56-150	31-174	40	40
	1,1,2-Trichloroethane	50	0.05	6.25	61-140	29-171	40	40
	Trichloroethene	50	0.05	6.25	77-139	37-171	40	40
	Vinyl acetate	50	0.05	6.25	26-200	5-239	40	40
	Vinyl chloride	50	0.05	6.25	26-188	6-215	40	40
	Xylenes (total)	150	0.15	18.75	14-181	7-211	40	40
	<b>SURROGATE:</b>							
	1,2-Dichloroethane-d4	50	0.05	6.25	77-113	72-117	NA	NA
	Toluene-d8	50	0.05	6.25	90-110	87-116	NA	NA
	4-Bromofluorobenzene	50	0.05	6.25	87-114	75-107	NA	NA
SW846 8080	<b>MATRIX SPIKE COMPOUND:</b>							
	Aldrin	0.4	0.013	0.4	45-120	28-172	40	40
	BHC, alpha isomer	0.2	0.007	0.2	39-131	15-171	40	40
	BHC, beta isomer	0.4	0.013	0.4	19-143	D-184	40	40
	BHC, delta isomer	0.4	0.013	0.4	24-138	8-164	40	40
	BHC, gamma isomer (Lindane)	0.2	0.007	0.2	36-124	12-160	40	40
	p,p'-DDD	0.8	0.027	0.8	35-139	12-172	40	40
	p,p'-DDE	0.4	0.013	0.4	36-141	17-177	40	40
	p,p'-DDT	0.8	0.027	0.8	30-154	13-185	40	40
	Dieldrin	0.4	0.013	0.4	38-142	18-178	40	40
	Endosulfan I	0.4	0.013	0.4	56-152	23-170	40	40
	Endosulfan II	0.8	0.027	0.8	22-194	5-213	40	40
	Endosulfan sulfate	0.8	0.027	0.8	27-141	5-185	40	40
	Endrin	0.4	0.013	0.4	32-146	18-178	40	40
	Endrin aldehyde	1	0.03	1	23-158	6-190	40	40
	Heptachlor	0.4	0.013	0.4	38-108	10-138	40	40
	Heptachlor epoxide	0.4	0.013	0.4	43-139	22-169	40	40
	Methoxychlor	4	0.13	4	29-169	D-195	40	40
	PCB-1016	10	0.33	10	54-114	36-144	40	40
	PCB-1260	10	0.33	10	15-123	D-161	40	40
	<b>SURROGATE:</b>							
	Dibutylchlorendate	1	0.066	1	36-137	D-168	NA	NA
	2,4,5,6-tetrachloro-m-xylene	1	0.066	1	65-145	D-142	NA	NA

**TABLE 1-16**  
**CONTROL LIMITS FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, AND SURROGATE SPIKES**  
**SCOTT AFB, ILLINOIS**

ANALYTICAL METHOD	SPIKING COMPOUND	SPIKE CONCENTRATION <sup>a</sup>			CONTROL LIMITS			
		WATER (µg/L)	SOIL/SEDIMENTS (mg/kg)		PERCENT RECOVERY (%)		RELATIVE PERCENT DIFFERENCE (%)	
			Low	Medium	WATER	SOIL/SEDIMENTS	WATER	SOIL/SEDIMENTS
LUFT CAL DHS	<b>MATRIX SPIKE COMPOUND:</b>							
	Gasoline	5.4	10.8	10.8	53-125	46-126	40	40
	Diesel	2.5	124	2.5	60-110	54-125	40	40
	<b>SURROGATE:</b>							
	o-Terphenyl	48.8	12.2	48.8	NE	NE	NA	NA
SW 846 8330	<b>MATRIX SPIKE COMPOUND:</b>							
	HMX	NE	NE	NE	50-113	42-119	45	56
	RDX	NE	NE	NE	68-120	70-123	61	68
	1,3,5-TNB	NE	NE	NE	60-110	70-118	30	40
	1,3-DNB	NE	NE	NE	63-121	60-125	42	51
	Tetryl	NE	NE	NE	71-117	68-126	68	72
	Nitrobenzene				68-109	62-117	35	42
	2,4,6-TNT	NE	NE	NE	60-115	74-129	40	45
	2,4-DNT	NE	NE	NE	64-117	68-109	35	40
	2,6-DNT	NE	NE	NE	66-119	63-124	45	49
SW846 9010/ 9012	<b>MATRIX SPIKE COMPOUND:</b>							
	Cyanide	NE	NE	NE	78-125	76-125	18	20

<sup>a</sup> The spike concentrations for these methods vary according to the expected concentrations of analytes in the sample.

NA - Not applicable.

NE - Not established at this time.

\* - No spike required.

\*\* - Precision and accuracy limits are based on method limits.

### 1.13.3 Data Quality Assessment

Statistical techniques can be used to evaluate the comparability of different sets of existing data and to evaluate the need to obtain additional data. The most commonly used statistical approach is the interpretation of accuracy and precision information. Another statistical approach is the use of geostatistical information which characterizes the location of the samples and the size of the site. Law will use accuracy and precision information to assess the confidence in the reported values and geostatistics of the validated data to identify contamination plumes.

The statistical treatments of data by Law are in accordance with current scientific concepts elucidated in standard references. Precision is a statistical term which describes the closeness of agreement between individual measured values of a given analyte in a given matrix at a given concentration of analyte using a specified analytical method. Precision is normally expressed in statistical terms, such as the standard deviation of the values about their mean, or as the coefficient of variation (CV), which is the standard deviation of the mean expressed as a percentage of the mean. Bias is similarly a statistical parameter which describes the deviation, with algebraic sign, of the mean values of many determinations of the analyte from its "true" value. This true value must either be known independently or determined by another independent method which is known to have no bias itself.

The precision and accuracy of environmental sample analysis are greatly dependent on the sample matrix and the level of analyte concentration, both of which determine what values of precision and accuracy (bias) are acceptable for the use intended. This dependence of precision and accuracy descriptors in analyses upon matrix and concentration requires the chemists involved to use professional judgement as to the range of values acceptable for repeat determinations of the same sample. Horwitz, Kamps, and

Boyer (1980) have shown this precision vs. concentration relationship to hold for a large number of methods, matrices, and analytes involved in regulatory programs.

All data generated within established concentration ranges for a particular analyte will be compared to developed Shewhard Control Charts, and they must meet pre-established quality control criteria for accuracy and precision. If the quality control criteria is not met, associated data will be qualified.

#### 1.13.4 Documentation

Completeness and comparability of data are insured by adherence to a standard data-set protocol and checklist of data required to be available on laboratory report sheets for each type of analysis conducted. Each parameter data book must contain all data and calculations associated with each independent determination. These include such things as sample weight(s), dilution factor(s), applicable determinative measurements such as titration values, spectrometer readings, injection quantities, and standard(s) identity and concentrations, as well as all calculations related to each final value reported. Each laboratory report sheet will be checked and initialed by a second competent scientist other than the person who did the analysis to insure completeness of data and correctness of all calculations in the report. For the occasional project involving very critical samples on which serious action is contemplated, the entire set of analyses on the same sample(s) will be independently audited by a special project quality assurance officer. For example, the analysis of drinking water samples from residential wells where compounds were found to exceed the MCL. Samples collected at Scott AFB are not considered to be in this category. All work sheets, chromatograms, spectra, etc., associated with every analysis will be present in the parameter data book. These will give instrument operation parameters and

details of instrument set-up, such as columns used, mobile and stationary phases and concentrations, temperatures, detectors, spectrometer type, wavelengths, etc., as applicable for the type analysis. All work sheets will bear a unique laboratory number identifying that sample, relating the laboratory data sheets to the sample. Each sheet will be recorded with dates and times and bear the laboratory analyst's initials.

#### 1.14 CORRECTIVE ACTION

An effective QC program requires rapid and thorough correction of the QC problems. Rapid corrective action (CA) minimizes the possibility of questionable data on any project. The need for corrective action originates when an inadequacy is found in the method of analysis (e.g., inappropriate calibration) or a determinate error occurs (e.g., calibration error due to standards failure). Failures of the first kind are precluded by LENL and Regulator/Contractee audits which evaluate analytical SOPs. The analytical SOPs incorporate mechanisms to detect the existence of determinate errors and specify the procedures to correct them. Depending on the nature of the CA, it is classified as one of two types, immediate and long-term. Immediate corrective actions are the correction of procedures or repair of instrumentation that is working improperly. Long-term corrective actions are the correction of systematic errors, such as the detector on a GC becoming dirty and losing sensitivity. Corrective actions associated with field activities are presented in the Field Sampling Plan.

##### 1.14.1 Response

Many times the source of a nonsystematic problem is obvious to the analyst and can be corrected immediately. Immediate corrective



action routinely made by field technicians or laboratory analysts should be documented as normal operating procedures in instrument log books or personal notebooks. The Supervisor and analyst should compile a list of commonly encountered problems and the appropriate routine corrective actions (in addition to manufacturer's troubleshooting guides).

The Operations Manager and QA/QC Coordinator are responsible for approving all corrective actions. Table 1-11 lists the corrective actions necessary for each analytical method. Corrective actions associated with sampling and collection or missed holding times are presented in Table 1-17.

#### 1.14.2 Reestablishment of Control

Corrective action is not complete until the problem has been effectively and permanently solved. Follow-up action to ensure that the problem remains corrected is a vitally important step in the corrective action procedure. Routine corrective actions, such as recalibrating the instrument, are incorporated into the Standard Operating Procedures (SOPs). Major corrective actions, such as a systems failure, are handled in the following manner: Once a problem has been technically defined, the Operations Manager and the QA/QC Coordinator discuss the problem and jointly take the following steps:

1. Determine that specific corrective action is needed to eliminate the problem and assign responsibility for investigating, implementing, and documenting the situation;
2. Set a time schedule for determining the required action;
3. Assign responsibility and time schedule to implement the desired action;

TABLE 1-17

**CORRECTIVE ACTION PROCEDURES(a)(b)**  
**Scott Air Force Base, IL**

SITUATION	FIELD OBJECTIVE AFFECTED	CORRECTIVE ACTION PROCEDURE
Field contamination (trip and ambient equipment blanks – VOC analysis and rinsates – all parameters analyzed)	Acquisition of defensible data	<ul style="list-style-type: none"> <li>– Notification of Law Project Manager and QAO by laboratory manager</li> <li>– Review ASTM Type II reagent water sources and replace if necessary; qualify data</li> <li>– Document to file for final report</li> </ul> <p>Note: Resampling may not be necessary if the level of contamination found does not exceed any known action levels, or interferes with the identification and quantitation of any nearby peak of interest</p>
Field contamination (interfering compounds detected in all blanks, except the laboratory method blank, and corresponding environmental samples) – VOC analysis	Acquisition of defensible, justifiable data	<ul style="list-style-type: none"> <li>– Notification of Law Project Manager and QAO by laboratory manager</li> <li>– Review situation, determine source of contamination and eliminate</li> <li>– Review level of contamination found and extent of affected samples; qualify data</li> <li>– Executive decision by Law Project Manager as to course of action</li> <li>– Document to file for final report</li> </ul>
Field contamination (equipment blanks only)	Acquisition of defensible data	<ul style="list-style-type: none"> <li>– Notification of Law Project Manager and QAO by laboratory manager</li> <li>– Review decontamination procedures and correct deficiencies</li> <li>– Document to file for final report</li> </ul> <p>Note: Resampling may not be necessary if the level of contamination found does not exceed any known action levels, or interferes with the identification and quantitation of any nearby peak of interest</p>

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TABLE 1-17

**CORRECTIVE ACTION PROCEDURES(a)(b)**  
**Scott Air Force Base, IL**

SITUATION	FIELD OBJECTIVE AFFECTED	CORRECTIVE ACTION PROCEDURE
No QC sample to support data from sample batch (For example, the lab neglects to prepare and analyze a method blank or a matrix spike)	Acquisition of defensible, justifiable data	<ul style="list-style-type: none"> <li>– Notification of site supervisory personnel by laboratory manager</li> <li>– Mail appropriate samples if available</li> <li>– If samples are not available, the Law Project Manager and QAO will be notified</li> <li>– Review site affected, impact of samples on site characterization, determine corrective action</li> <li>– Document to file for final report</li> </ul>
Duplicate or replicate RPDs outside of control limits	Acquisition of defensible, justifiable data	<ul style="list-style-type: none"> <li>– Notification of Law Project manager and QAO by laboratory manager</li> <li>– Re-analysis of in-house samples by the laboratory</li> <li>– Review site affected and impact of samples on site characterization</li> <li>– Executive decision by Law Project Manager concerning the importance of affected data</li> <li>– Document to Project manager and QAO</li> </ul>
Expired samples (holding times exceeded)	Acquisition of defensible, justifiable data	<ul style="list-style-type: none"> <li>– Notification of Law Project Manager and QAO by laboratory manager</li> <li>– Review of site affected and impact of samples on site characterization</li> <li>– Executive decision by Law Project Manger concerning the importance of the affected data</li> <li>– Resample if necessary</li> <li>– Document to Law Project Manager and QAO</li> </ul>

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TABLE 1-17

**CORRECTIVE ACTION PROCEDURES(a)(b)**  
**Scott Air Force Base, IL**

SITUATION	FIELD OBJECTIVE AFFECTED	CORRECTIVE ACTION PROCEDURE
Temperature of Cooler above 4°C	Acquisition of defensible, justifiable data	<ul style="list-style-type: none"> <li>- Notification of Law Project Manager and QAO by laboratory manager</li> <li>- Notification of site supervisory personnel by Law Project Manager</li> <li>- Review of site affected and impact of samples on site characterization</li> <li>- Executive decision by Law Project Manager concerning the importance of the affected data</li> <li>- Document to Law Project Manager and QAO</li> </ul>

(a) Corrective action situations too numerous to list. Table illustrates several examples.

(b) The AFCEE TPM will be notified if corrective action needs clarification as to whether resampling is required.

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4. Establish desired effectiveness of the corrective action and implement the correction; and
5. Verify that the corrective action has eliminated the problem and document.

Table 1-11 lists the corrective actions necessary for each analytical method.

#### 1.14.3 Documentation

To provide a complete record of QC activities all QC problems and corrective actions applied must be documented. Historical records assist laboratory management in identifying long-term corrective actions, such as personnel training, replacement of instrumentation, improvement of sampling procedures, etc.

A corrective action requires defined responsibilities for scheduling, performing, documenting, and assuring the effectiveness of the action.

A quality assurance corrective action request and routing form (Figure 1-10) is used to document all long-term corrective actions taken. The form may be initiated by any individual who observes a major problem. If more than one problem is involved, each problem should be documented on a separate corrective action request form.

Copies of the form are given to the Supervisor responsible for the analysis, the Operations Manager, and the QA/QC Coordinator. During the weekly staff meeting, a standing item for discussion is QA problems encountered that week.

A corrective action status form (Figure 1-11) is used to monitor the status of all corrective actions. This form is updated weekly

FIGURE 1-10  
**QA/QC CORRECTIVE ACTION REQUEST FORM**

LENL-PENSACOLA, FL

CA # \_\_\_\_\_ Originator \_\_\_\_\_ DATE \_\_\_\_\_

**PROBLEM:**

SECTION: \_\_\_\_\_ DISCOVERER: \_\_\_\_\_ DATE: \_\_\_\_\_

DATA/DATES IMPACTED: \_\_\_\_\_

DESCRIPTION: \_\_\_\_\_

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**REQUIRED ACTION:**

**DETERMINATION**

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

**IMPLEMENTATION**

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

ACTION: \_\_\_\_\_

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**EFFECTIVENESS EVALUATION (S):**

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

ASSIGNED TO: \_\_\_\_\_ DATE: \_\_\_\_\_ DUE DATE: \_\_\_\_\_

CC: QA OFFICER \_\_\_\_\_

OPERATIONS MANAGER: \_\_\_\_\_

GROUP LEADER: \_\_\_\_\_

SECTION SUPERVISOR: \_\_\_\_\_



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and distributed at the staff meeting with management. Corrective action documentation associated with field activities are recorded on Daily Quality Control Forms. These forms are presented in the Field Sampling Plan.

#### 1.15 QUALITY ASSURANCE REPORTS

The management is informed of QA activities in three ways: (1) by immediate verbal notification of QA problems, (2) by interim QA reports, and (3) a written final QA report.

##### 1.15.1 Report Content and Reporting Procedure

A final report will be prepared and submitted to Law Environmental Government Services Branch at the end of a project by the QA/QC Coordinator. Interim QA reports are prepared for projects lasting more than 6 months. These reports will include the following QA items:

- An assessment of QC (accuracy, precision, and completeness)
- Performance and system audit results
- Significant QA problems encountered and results of corrective actions taken
- Position of the individual preparing the QA reports.



## 2.0 FIELD SAMPLING PLAN (FSP)

The following sections describe the plans and procedures to be used during the field sampling activities.

### 2.1 FIELD OPERATIONS

This section of the Field Sampling Plan for Scott AFB describes the field operations which will be conducted as part of this investigation. Activities will include the following:

- Site Reconnaissance and Preparation
- Soil Gas Survey
- Soil Borings
- Monitoring Well Installation
- Hydropunch/Soil Borings
- Aquifer Testing
- Soil Vapor Extraction Testing
- Surveying
- Equipment Decontamination
- Waste Handling

Section 3.0 of the Work Plans describes in general terms the tasks that will be performed at each of the eight IRP sites. These tasks are summarized on a site by site basis in Tables 2-1 through 2-8. Table 2-9 provides details of the field tasks to be completed in connection with the background data requirements for the project. Figures 2-1 through 2-8 show the proposed monitoring well, soil boring and sampling locations at each of the sites.

In the following sections the methods and procedures to be adopted for each of the activities is described.

**TABLE 2-1**  
**FIELD TASKS FOR REMEDIAL INVESTIGATION**  
**Site 1 - Landfill**  
**Scott AFB, Illinois**

Field Tasks	Rationale
<ol style="list-style-type: none"> <li>1. Conduct a soil gas survey</li> <li>2. Install 12 additional shallow monitoring wells (MW1-12 to MW1-23) with 20 foot screens intersecting water table.</li> <li>3. Install 4 additional deep monitoring wells (MW1-12D, MW1-13D, MW1-14D, MW1-16D) with 20 foot screens, immediately above bedrock, and one deep recovery well with 30' screen immediately above bedrock (MW1-15R).</li> <li>4. Collect ground-water samples from each of the 17 new monitoring wells.</li> <li>5. Collect ground-water samples from six of the existing wells (MW1-4, MW1-7, MW1-9, MW1-10S, MW1-10D, MW1-11).</li> <li>6. Collect subsurface soil samples from the borings for MW1-17 through MW1-23, MW1-12D, MW1-13D, MW1-14D, MW1-15R, MW1-16D; three from each deep well boring (one at water table, one at zone with highest head space reading using PID, and one at base of boring); two from each shallow well boring (one at water table and one at zone with highest head space reading).</li> <li>7. Collect twenty surface soil samples (SS1-9 to SS1-28).</li> <li>8. Collect five surface water and sediment samples from locations SW/SD1-7 to SW/SD1-11.</li> </ol>	<ol style="list-style-type: none"> <li>1. To aid in the delineation of the likely extent of the contaminant plume.</li> <li>2. To define the nature and extent of ground-water contaminants in the shallow part of the aquifer and extend the ground-water database.</li> <li>3. To define nature and extent of ground-water contamination in the deeper part of the aquifer and extend the ground-water database.</li> <li>4. To define nature and extent of ground-water contamination and to extend ground-water database.</li> <li>5. To monitor trends in the contaminant levels downgradient from the site, and to expand the ground-water database.</li> <li>6. Determine the nature and extent of subsurface soil contamination.</li> <li>7. To define nature and extent of contamination in surface soils.</li> <li>8. To determine nature and extent of surface water contamination.</li> </ol>

**TABLE 2-1****FIELD TASKS FOR REMEDIAL INVESTIGATION**

**Site 1 - Landfill  
Scott AFB, Illinois**

<b>Field Tasks</b>		<b>Rationale</b>	
9.	Conduct twice daily water level measurements in five existing wells over a three month period using Well Sentinel single channel data logger, and install 3 stream gauging stations.	9.	To improve the understanding of hydrogeologic conditions at the site (potentiometric surface, ground-water flow direction, hydraulic gradient).
10.	Conduct a complete round of water level measurements in all existing wells at beginning of field work and then during field sampling effort.	10.	To improve the understanding of hydrogeologic conditions at the site (potentiometric surface, ground-water flow direction, hydraulic gradient).
11.	Conduct a pumping test	11.	To further determine the hydrogeologic conditions at the site.
12.	Collect one hydropunch sample near MW1-15R location.	12.	To evaluate contamination in low portion of aquifer in the vicinity of pump test site.

**TABLE 2-2**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 2 - Fire Protection Training Area No.1  
Scott AFB, Illinois**

Field Tasks	Rationale
1. Collect 5 surface soil samples (SS2-1 to SS2-5).	1. To assess the levels of contamination in surface soils on basis of high soil gas measurements in previous study.

**TABLE 2-3**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 3 - Fire Protection Training Area No.2  
Scott AFB, Illinois**

Field Tasks	Rationale
1. Install two additional monitoring wells (MW3-4 and MW3-5) with 20' well screens intersecting water table.	1. To further define the nature and the extent of ground-water contamination in the shallow part of the aquifer.
2. Collect ground-water samples from the new monitoring wells and from existing wells MW3-2 and MW3-3.	2. To further define the nature and the extent of ground-water contamination in the shallow part of the aquifer.
3. Collect two soil samples from the borings for monitoring wells MW3-4 and MW3-5, from the zones which exhibit highest head space readings.	3. To define the nature and extent of subsurface soil contamination.
4. Drill 2 additional soil borings (SB3-3, SB3-4). Collect two samples, one each from the two zones that exhibit the highest head space reading.	4. To define nature and extent of subsurface soil contamination, and expand geological database for the site.
5. Collect five surface soil samples (SS3-1 to SS3-5).	5. To more accurately determine the levels of metals contamination in surface soils.

**TABLE 2-4**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 4 - Fire Protection Training Area No.3  
Scott AFB, Illinois**

Field Tasks	Rationale
1. Use Hydropunch to collect ground-water samples from 30 locations. Analyze samples with Field GC. Select monitoring well locations on basis of results.	1. To aid in the selection of suitable monitoring well locations. To determine the extent of ground-water contamination in the shallow part of the aquifer.
2. Install one additional shallow monitoring well (MW4-4) with 20' well screens intersecting water table, and one deep monitoring well (MW4-4D) with well screen immediately above bedrock.	2. To determine nature and extent of tetrachloroethene contamination downgradient from site, and to evaluate nature and extent of other contaminants in ground water.
3. Collect ground-water samples from new monitoring wells MW4-4 and MW4-4D.	3. To determine nature and extent of tetrachloroethene contamination downgradient from site, to evaluate nature and extent of other contaminants in ground water, and to extend the ground-water database.
4. Install two additional shallow monitoring wells (MW4-5 and MW4-6) at locations to be determined by results of Hydropunch/ Field GC sampling and analysis.	4. To determine nature and extent of ground-water contamination in the shallow part of the aquifer and extend the ground-water database.
5. Collect two subsurface soil samples from borings MW4-5 and MW4-6, one at water table and one at zone which exhibits highest head space reading.	5. To determine nature and extent of subsurface soil contamination.
6. Collect three subsurface soil samples from the boring for MW4-4D. One at the water table, one at zone which exhibits highest head space reading, and one at base of well.	6. To determine nature and extent of subsurface soil contamination.
7. Collect ground-water samples from new monitoring wells MW4-5 and MW4-6, and existing wells MW4-1 and MW4-2.	7. To determine nature and extent of contamination downgradient from the site.

**TABLE 2-4**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 4 - Fire Protection Training Area No.3  
Scott AFB, Illinois**

Field Tasks	Rationale
8. Drill four soil borings (SB4-4 to SB4-7) and collect two samples from each boring, one each from the two zones that exhibit the highest head space reading.	8. To determine nature and extent of contamination in subsurface soils.
9. Conduct aquifer (slug/bail) tests in MW4-4, MW4-4D, MW4-5 and MW4-6.	9. To further define the hydrological conditions at the site and to extend the ground-water database.

**TABLE 2-5**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 5 - Facility 8550 Spill Site  
Scott AFB, Illinois**

Field Tasks	Rationale
1. Use Hydropunch to collect ground-water samples from 30 locations. Analyze samples with Field GC. Use results to determine optimum positions of downgradient monitoring wells.	1. To aid in the location of downgradient monitoring wells. To delineate extent of contaminant plume.
2. Install two shallow downgradient monitoring wells (MW5-5 and MW5-6), with 20' screens that intersect water table.	2. To determine nature and extent of ground-water contamination in the shallow aquifer downgradient from the site.
3. Collect two subsurface soil samples from each of the borings for MW5-5 and MW5-6. One from each of the two zones that exhibit the highest head space readings.	3. To determine nature and extent of subsurface soil contamination.
4. Install one shallow monitoring well upgradient from the site (MW5-4) with 20' screen that intersects water table.	4. To determine nature and extent of ground-water contamination.
5. Collect two subsurface soil samples from the boring for MW5-4. One from each of the two zones that exhibit the highest head space reading.	5. To provide upgradient soil samples for risk assessment purposes.
6. Collect ground-water samples from the three new monitoring wells (MW5-4, MW5-5 and MW5-6).	6. To determine nature and extent of ground-water contamination.
7. Collect five surface water and sediment samples (SW/SD5-1 to SW/SD5-5).	7. To determine nature and extent of surface water contamination.
8. Collect 10 surface soil samples (SS5-1 to SS5-10)	8. To determine magnitude and extent of surface soil contamination. Evaluate dermal exposure.



TABLE 2-6

**FIELD TASKS FOR REMEDIAL INVESTIGATION**  
**Site 6 - Facility 1965 Spill Site**  
**Scott AFB, Illinois**

Field Tasks	Rationale
1. Drill 20 soil borings to water table. Collect soil samples at the 2 zones in each boring which exhibit highest head space reading.	1. To determine nature and extent of subsurface soil contamination. To facilitate use of Hydropunch to collect ground-water samples.
2. At each of the 20 soil borings, use Hydropunch to collect a ground-water sample (HP6-1 to HP6-20).	2. To determine nature and extent of ground-water contamination, and delineate contaminant plume.
3. Use Field GC to analyze ground-water and soil samples from Hydropunch locations.	3. To determine nature and extent of ground-water contamination. Laboratory analyses will provide confirmation of results.
4. Install one 6" pumping well (MW6-8R), with screen extending from above water table to approx. 35' gsl.	4. To provide a pumping well for pumping test and for soil vapor extraction test, to further define hydrological conditions and evaluate remedial alternatives (pump and treat, air stripping).
5. Collect 2 soil samples from the boring for MW6-8R. One each from the two zones that exhibit the highest head space reading.	5. To determine nature and extent of subsurface soil contamination.
6. Install 4 monitoring wells (MW6-4, MW6-5, MW6-6, MW6-7), with screen extending from approx. 2' gsl to approx. 30' gsl.	6. To provide monitoring points for pumping test, to further define hydrological conditions, and evaluate remedial alternatives.
7. Collect 2 soil samples from each of the borings for the 4 new monitoring wells. One from each of the two zones that exhibit the highest head space readings.	7. To determine nature and extent of subsurface soil contamination.
8. Collect ground-water samples from the recovery well (MW6-8R), from each of the 4 new monitoring wells (MW6-4, MW6-5, MW6-6 and MW6-7) and from existing monitoring well MW6-2.	8. To determine nature and extent of ground-water contamination and extend the ground-water database.

**TABLE 2-6**  
**FIELD TASKS FOR REMEDIAL INVESTIGATION**  
**Site 6 - Facility 1965 Spill Site**  
**Scott AFB, Illinois**

Field Tasks	Rationale
9. Conduct an eight-hour step drawdown test.	9. To determine maximum sustainable pumping rate for pumping test.
10. Conduct a 24-hour pumping test.	10. To evaluate the hydrogeologic conditions at the site and to evaluate suitability of pump and treat remedial options.
11. Conduct a ground-water recovery test.	11. To evaluate site hydrogeologic conditions.
12. Conduct a vapor extraction test.	12. To evaluate vapor extraction as a remediation alternative.

**TABLE 2-7**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 7 - Sludge Weathering Lagoon  
Scott AFB, Illinois**

Field Tasks	Rationale
1. Collect 18 hydropunch ground-water samples to be analyzed with a field GC operation (9 shallow, 9 deep).	1. Evaluate nature and extent of potential ground-water contamination.
2. Collect 2 hydropunch ground-water samples with QA/QC from hot spots. Sample analyses are to be performed by approved laboratory.	2. Collect ground-water contaminant concentrations for risk assessment purposes.
3. Collect 4 surface water and 4 sediment samples; 3 from drainage ditch and 1 at Silver Creek discharge point.	3. Evaluate water quality in the ditch and potential impact to Silver Creek.

**TABLE 2-8**

**FIELD TASKS FOR REMEDIAL INVESTIGATION  
Site 8 - Building 1680  
Scott AFB, Illinois**

Field Tasks	Rationale
1. Cover surface soils in crawlspace with plastic sheeting.	1. Eliminate surface soil exposures during utility maintenance activities and reduce potential for mercury vapor emissions.

Table 2-9

**FIELD TASKS FOR REMEDIAL INVESTIGATION**  
**Background Location**  
**Scott Air Force Base, Illinois**

Field Tasks		Rationale	
1.	Install two shallow monitoring wells (MWB-1, MWB-2) with twenty foot screens intersecting the water table.	1.	To provide background data for shallow ground water.
2.	Collect 2 soil samples per boring from the borings for MWB-1 and MWB-2. One immediately below surface and one at water table.	2.	To provide background soils data.
3.	Install two deep monitoring wells (MWB-1D, MWB-2D) with twenty foot screens situated immediately above bedrock.	3.	To provide background ground-water data.
4.	Collect 3 soil samples per boring from the borings for MWB-1D and MWB-2D. One from immediately below surface, one at water table and one at base of boring.	4.	To provide background soils data.
5.	Collect one ground-water sample on 3 occasions from MWB-1, MWB-1D, MWB-2, MWB-2D.	5.	To provide background ground-water data.
6.	Collect ten surface soil samples.	6.	To provide background surface soil data.
7.	Collect 1 surface water and sediment sample on 3 occasions from upstream location in Silver Creek.	7.	To provide background surface water and sediment data.
8.	Collect 2 downstream surface water and sediment samples from Silver Creek.	8.	To evaluate overall impact of Scott AFB activities on water quality in Silver Creek.

**FIGURE 2-1a**

## PROPOSED MONITORING WELL LOCATIONS

## SITE 1 LANDFILL

SCOTT AIR FORCE BASE, ILLINOIS

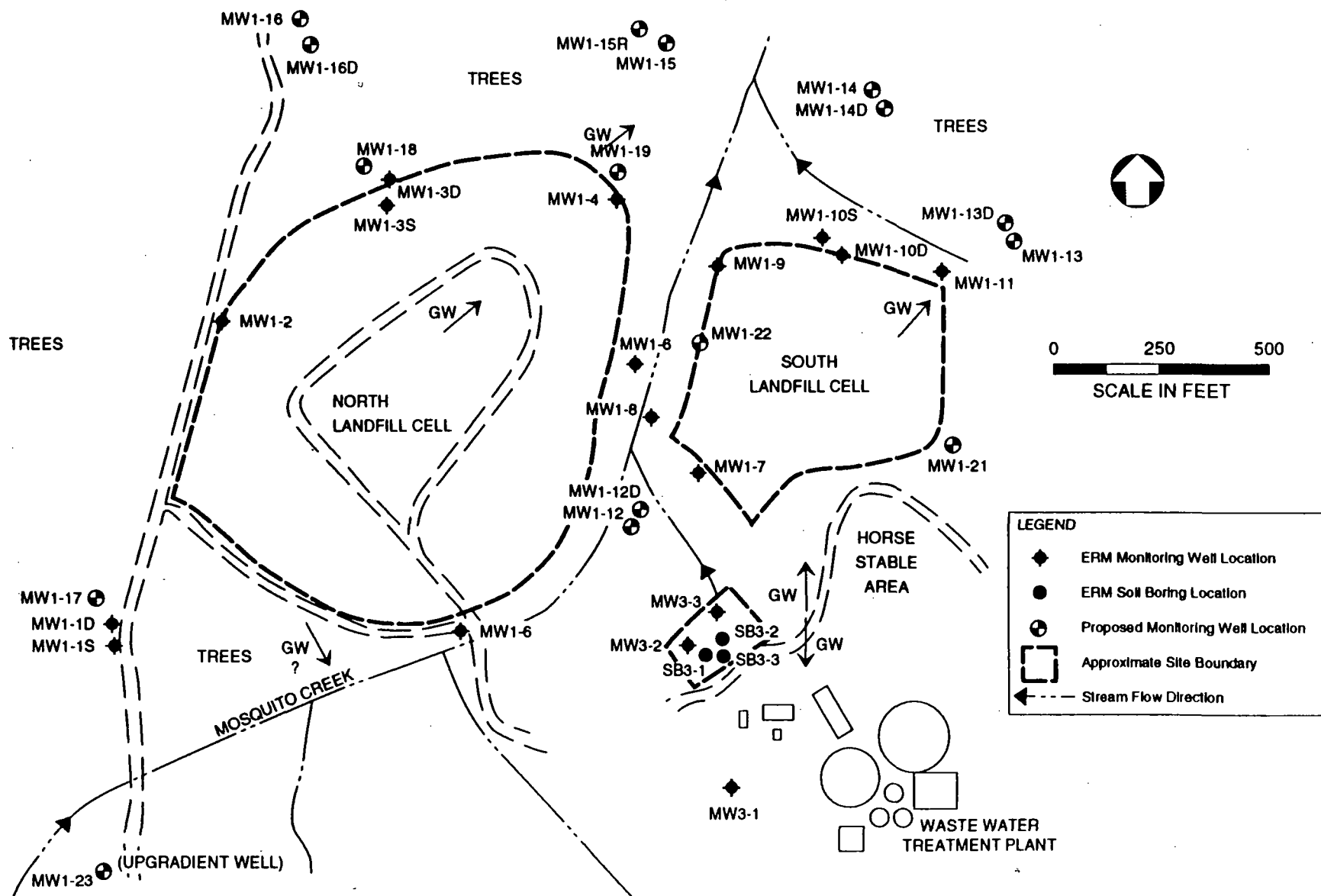


FIGURE 2-1b

# **PROPOSED SURFACE SOIL, SURFACE WATER & SEDIMENT SAMPLING LOCATIONS** **SITE 1 LANDFILL** **SCOTT AIR FORCE BASE, ILLINOIS**

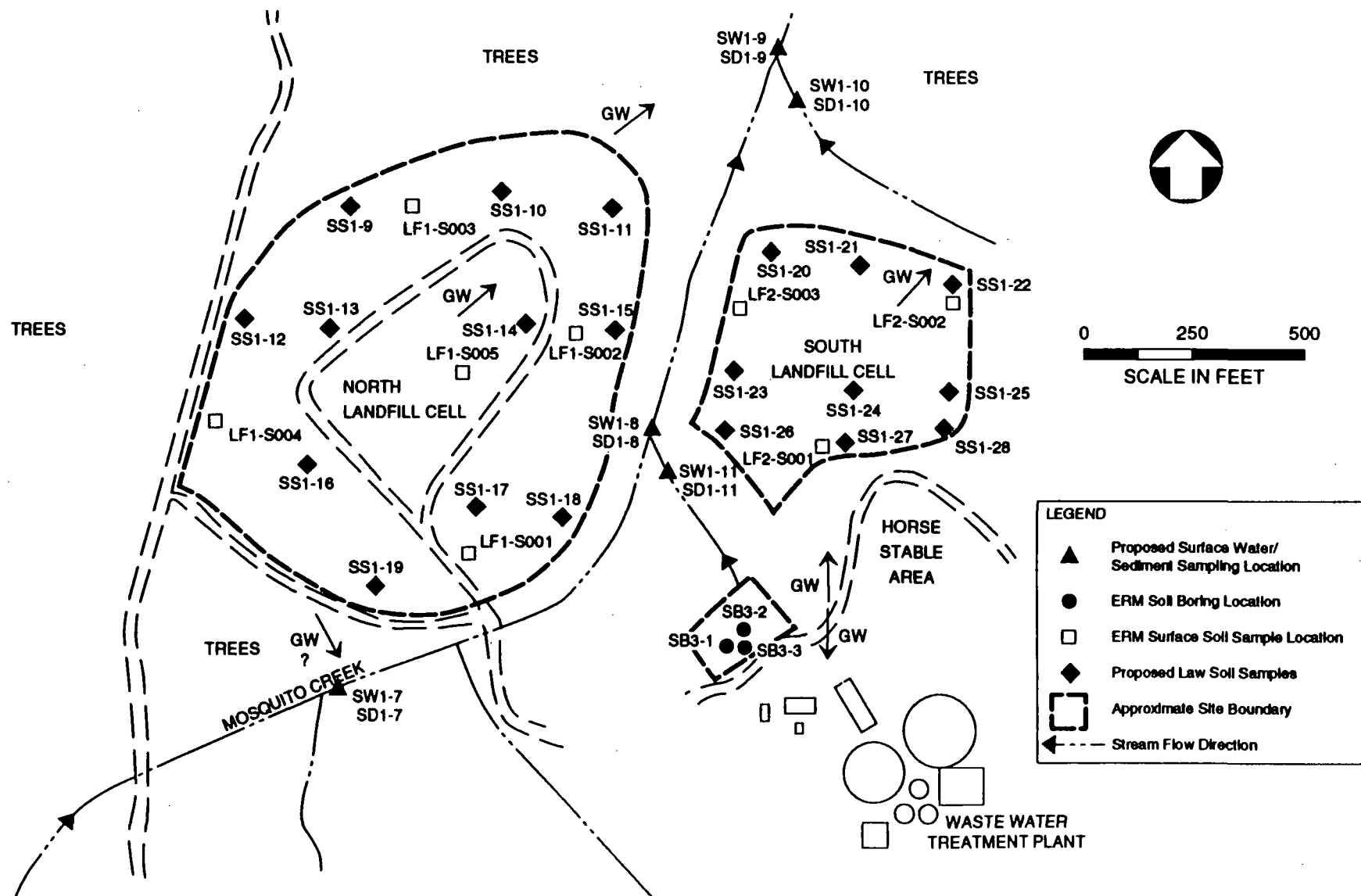
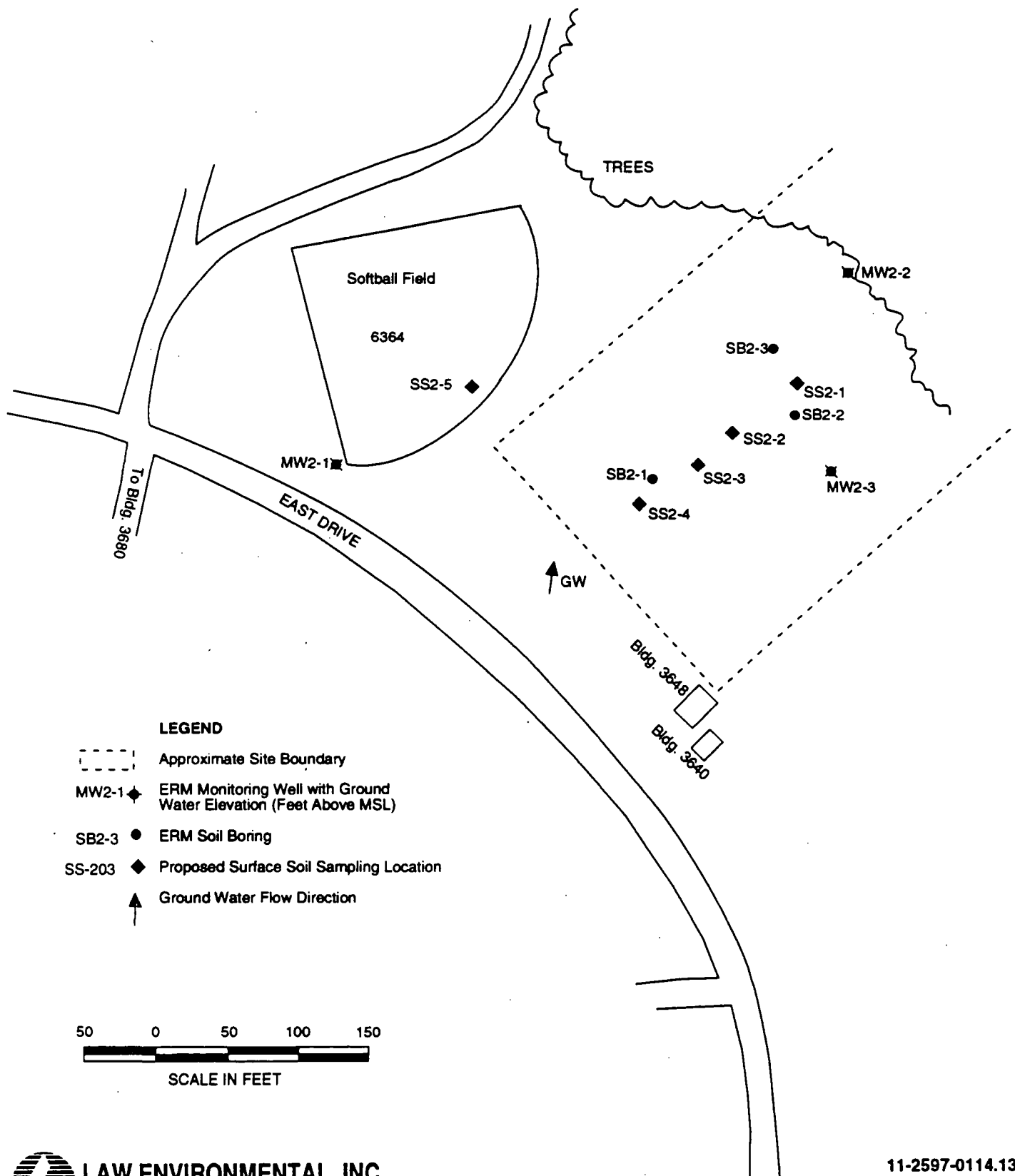


FIGURE 2-2  
**SITE 2-FPTA NO.1**  
 PROPOSED SAMPLING LOCATIONS  
 SCOTT AIR FORCE BASE, ILLINOIS

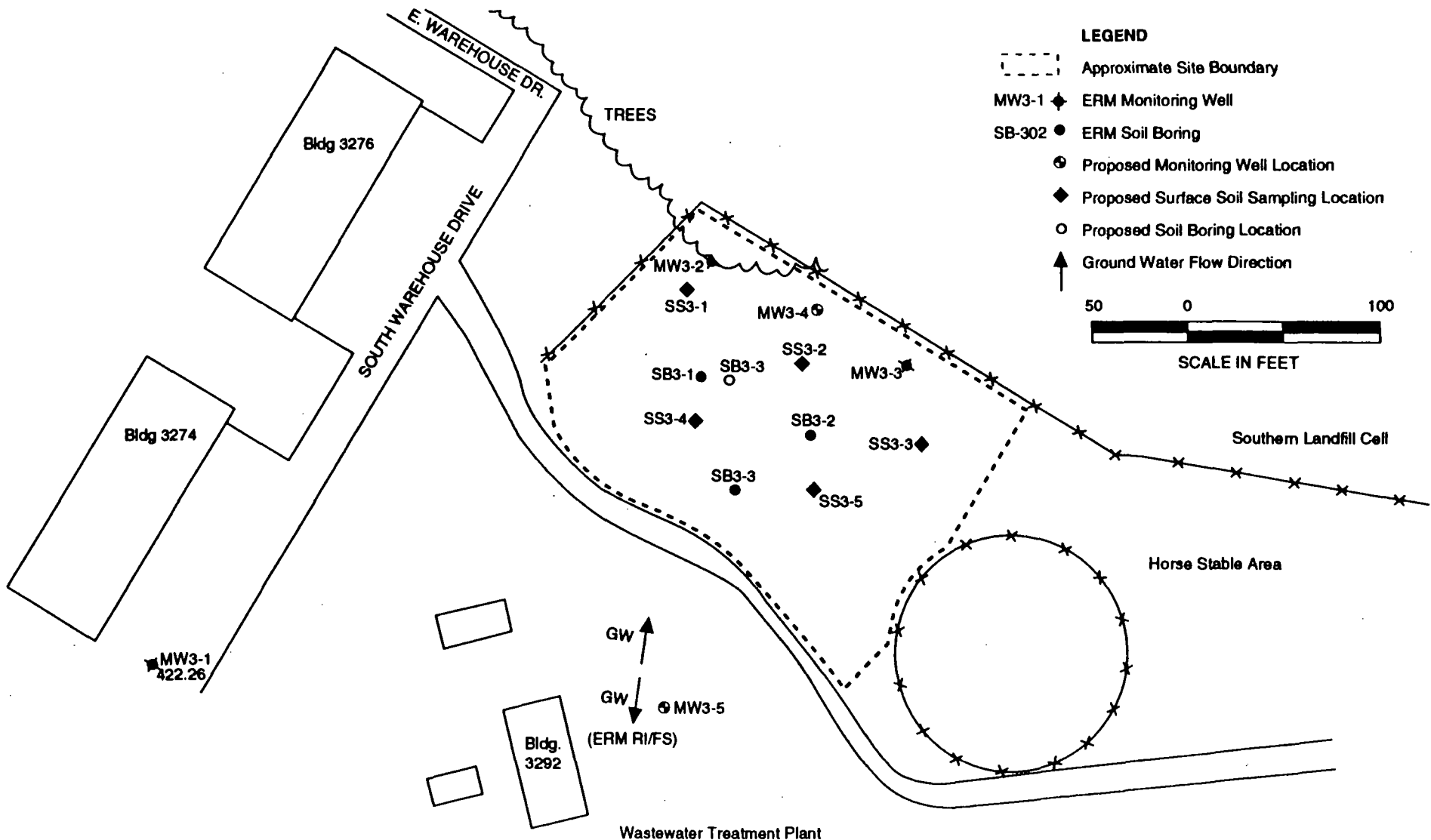


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FIGURE 2-3  
**SITE 3 FPTA NO. 2**  
 PROPOSED SAMPLING LOCATIONS  
 SCOTT AIR FORCE BASE, ILLINOIS



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FIGURE 2-4  
**SITE 4 - FPTA NO. 3**  
 PROPOSED SAMPLING LOCATIONS  
 SCOTT AIR FORCE BASE, ILLINOIS

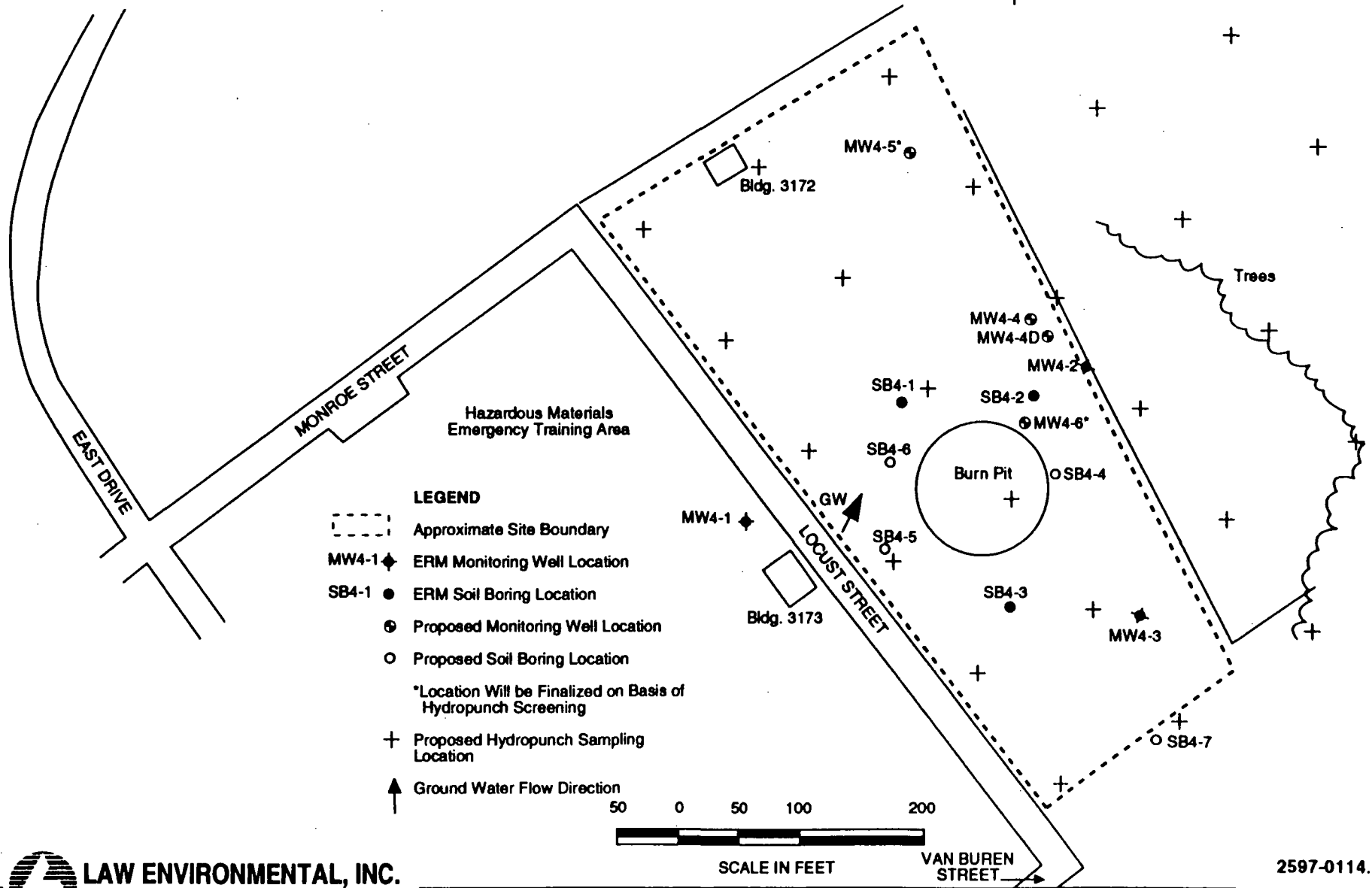


FIGURE 2-5  
**SITE 5 - FACILITY 8550**  
 PROPOSED HYDROPUNCH SAMPLING LOCATIONS  
 SCOTT AIR FORCE BASE, ILLINOIS

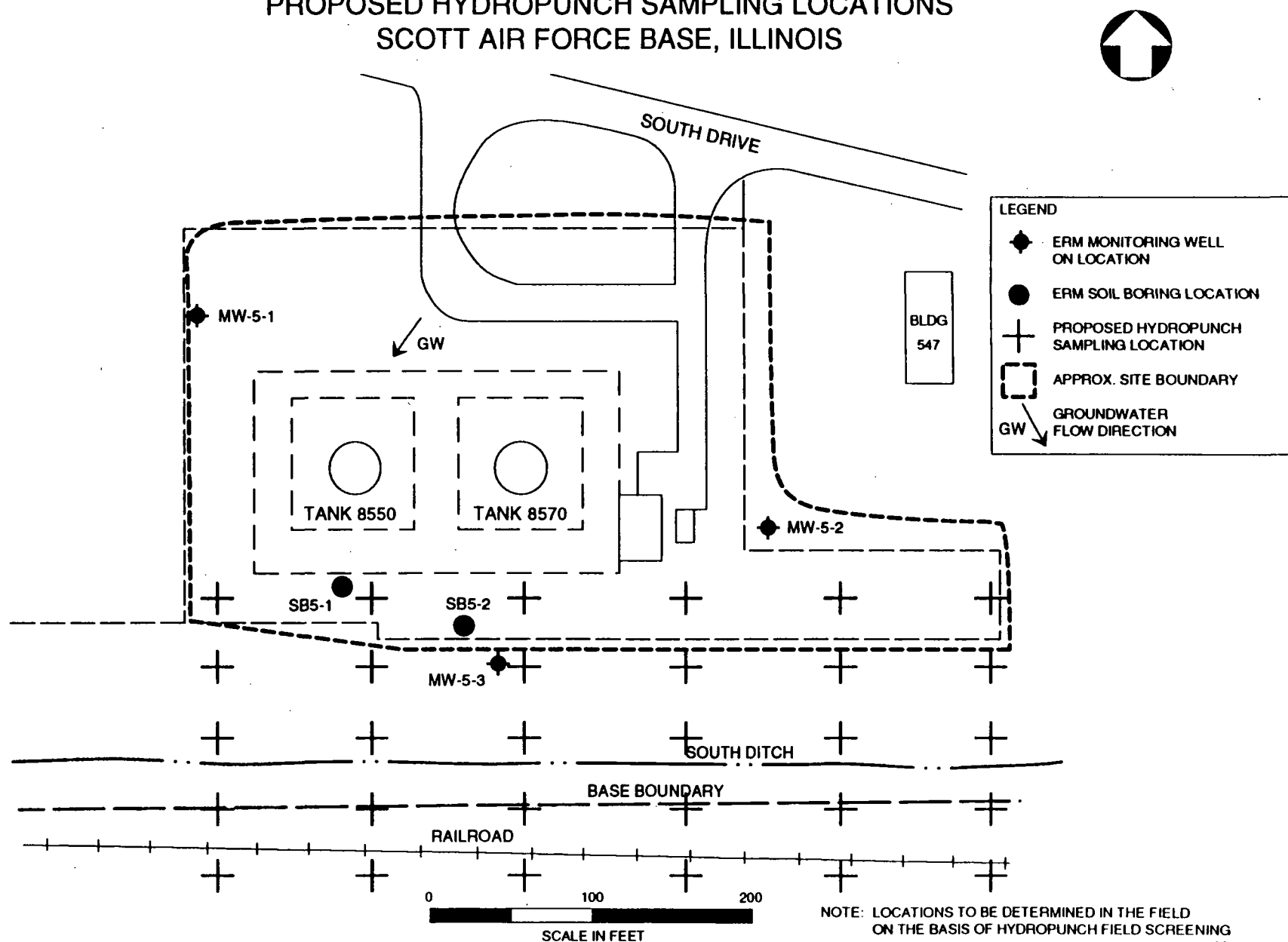


FIGURE 2-6  
**SITE 5 - FACILITY 8550**  
 PROPOSED SAMPLING LOCATIONS  
 SCOTT AIR FORCE BASE, ILLINOIS

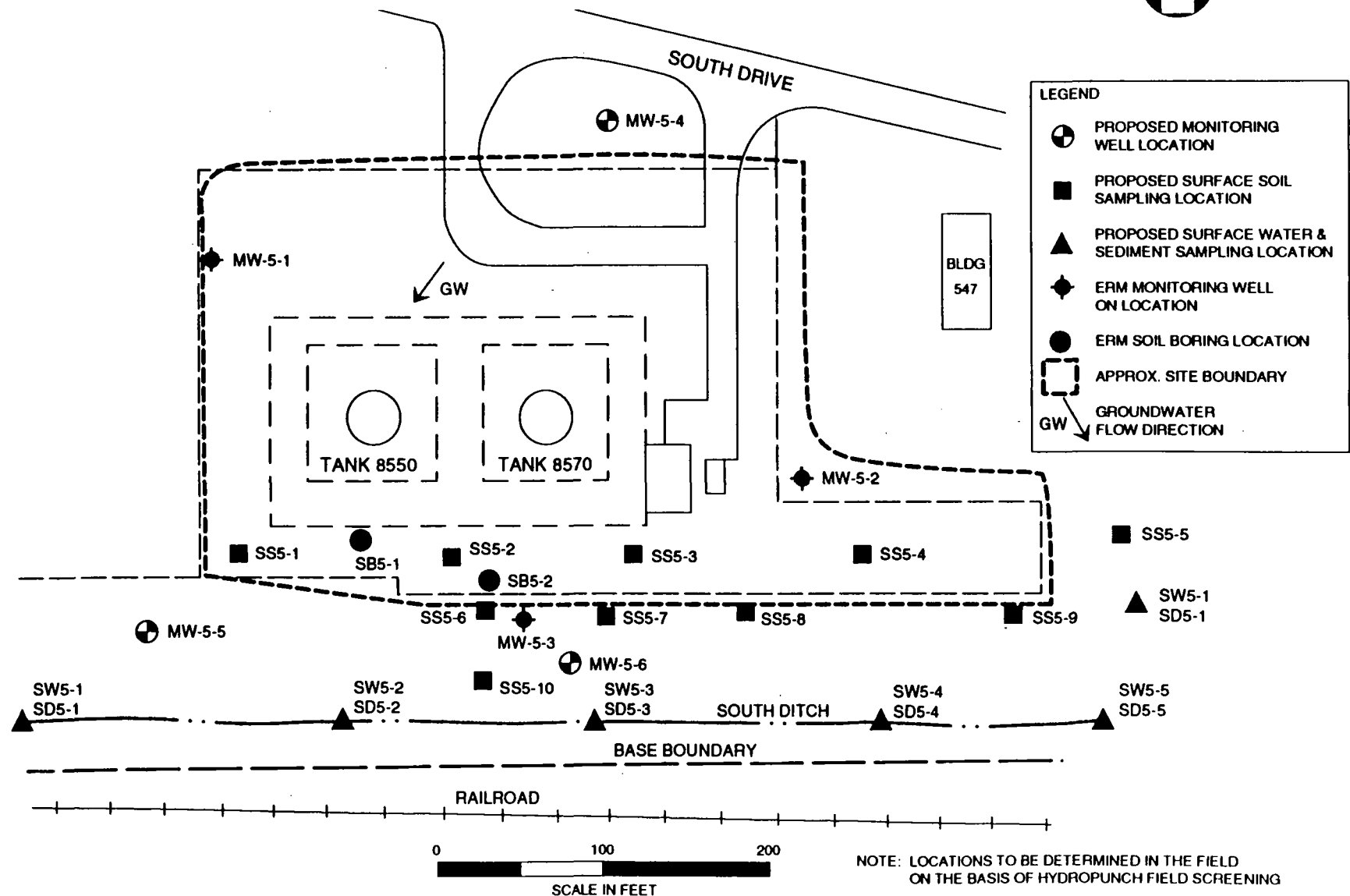
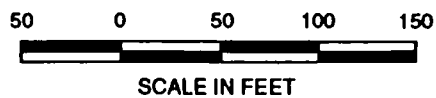
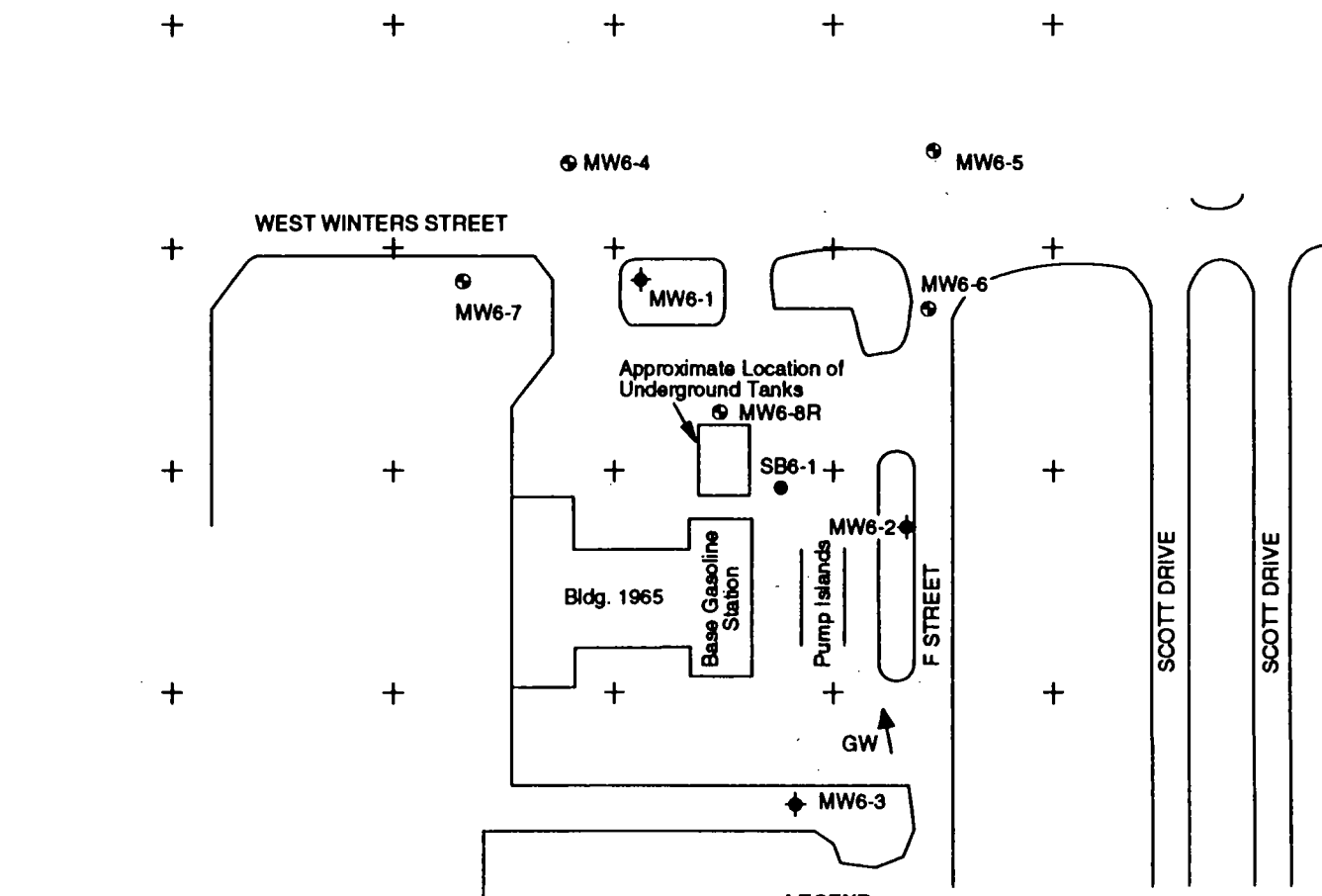


FIGURE 2-7  
**SITE 6 – FACILITY 1965**  
 PROPOSED SAMPLING LOCATION  
 SCOTT AIR FORCE BASE, ILLINOIS



**LEGEND**

- MW6-1 + ERM Monitoring Well Location
- SB6-1 • ERM Soil Boring Location
- ⊕ Proposed Monitoring Well Location
- + Proposed Hydropunch Sampling Location



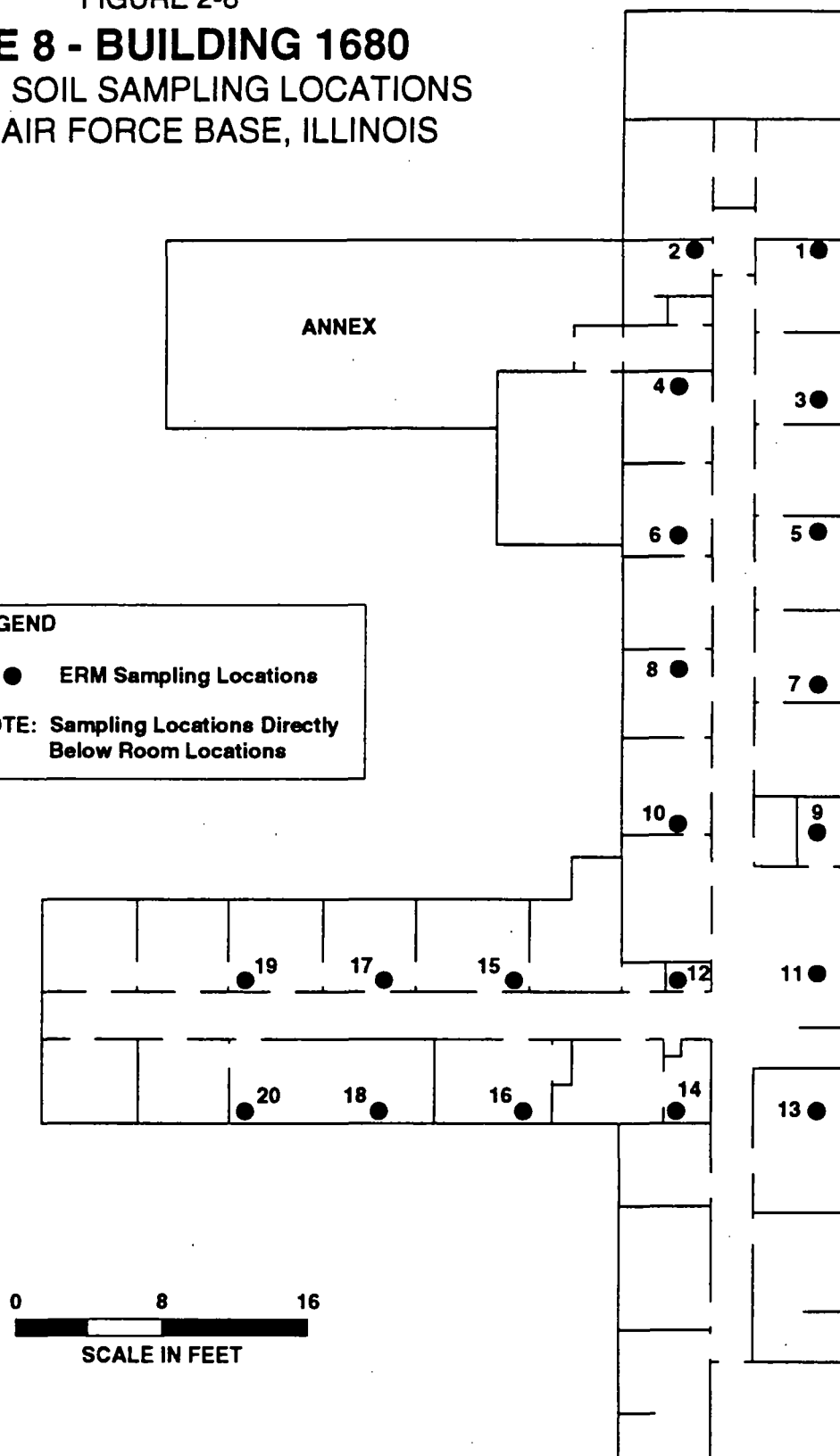
FIGURE 2-8  
**SITE 8 - BUILDING 1680**  
 EXISTING SOIL SAMPLING LOCATIONS  
 SCOTT AIR FORCE BASE, ILLINOIS



**LEGEND**

6 ● ERM Sampling Locations

NOTE: Sampling Locations Directly  
 Below Room Locations



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### 2.1.1 Site Reconnaissance, Preparation and Restoration

Prior to commencement of operations at each of the sites, the Law Site Manager will conduct a site reconnaissance to determine requirements for site preparation and clearance. Site preparation will include clearance of brush and other obstructions. At this time, all proposed drilling and sampling locations will be clearly staked and marked. Clearance for utilities at all drilling locations will then be conducted by liaison with base operations and maintenance staff and/or civilian utility operators where appropriate. Drilling locations will, if necessary, be relocated so as to avoid utilities. The new locations will be chosen in order to achieve the same objectives as were intended for the original location. No intrusive activities will be conducted until clearance for utilities has been completed.

The Law Site Manager will also discuss the locations of the decontamination area, emergency equipment and a drum staging area prior to commencement of operations, with the relevant personnel on base.

Following the completion of drilling and sampling at each location, the Law Site Manager will visit the location and will verify that the site has been cleared and restored as closely as possible to the same condition as it was in prior to the commencement of operations. All trash will be removed from the site, and surface damage (e.g., wheel ruts) caused during the drilling and sampling operation will be repaired.

### 2.1.2 Soil Gas Survey

A Soil Gas Survey will be conducted at Site 1 - Landfill by Target Environmental Services (TARGET), under the direction of Law field staff. The survey will cover the entire landfill area. Sampling

will be conducted at either single or variable depths ranging from 2' to 10', subsurface conditions permitting. (IEPA recommend screening at 2, 5 and 10'). Sampling points will be spaced on a 50' grid. The survey will be conducted in an effort to identify areas of anomalously high concentrations of volatile organic compounds (VOCs). The results of the survey will be used to aid in delineating the extent of contamination, and hence the required layout of any remediation equipment to be installed at this site. Each sampling point will be analyzed for aromatic and halogenated volatile organic compounds by gas chromatography with flame ionization (FID) and electron capture (ECD) detectors. Soil gas samples will be shipped to TARGET's in-house laboratory for analyses. Appendix A presents TARGET's Standard Operating Procedure (SOP) for soil gas survey, and includes details of the QA/QC procedures for this aspect of the investigation.

#### 2.1.3 Soil Borings

Soil borings will be drilled at seven of the eight sites, in order to obtain subsurface soil samples, define subsurface stratigraphy, and in some instances, to facilitate the installation of monitoring wells. Table 2-10 provides details of the soil borings to be drilled at each of the sites. Table 2-11 provides details of the soil samples to be collected from each boring. The anticipated depths of borings listed in Table 2-10 are approximate, and are based on the anticipated depth to the water table or to bedrock.

The soil boring operation will be observed by a state licensed Geologist or Engineer. The Geologist/Engineer will log the subsurface conditions encountered during drilling, and will record his observations on a Soil Boring Log (Figure 2-9). Observations will include (but will not be limited to) the following:

- Boring or Well Identification
- Purpose of Boring (soil sampling, monitoring well)



TABLE 2-10

**SOIL BORING DETAILS**  
**Scott Air Force Base, Illinois**

Site	No. of Borings <sup>(a)</sup>	Boring I.D	Approximate Depth (gsl)	No. of samples
PILOT BORINGS	3	SBP-1	40'MAX	0
		SBP-2	40'MAX	0
		SBP-3	40'MAX	0
1 - Landfill	17(17)	MW1-12	20-30'	0
		MW1-13	20-30'	0
		MW1-14	20-30'	0
		MW1-15	20-30'	0
		MW1-16	20-30'	0
		MW1-17	20-30'	2
		MW1-18	20-30'	2
		MW1-19	20-30'	2
		MW1-20	20-30'	2
		MW1-21	20-30'	2
		MW1-22	20-30'	2
		MW1-23	20-30'	2
		MW1-12D	70-80'	3
		MW1-13D	70-80'	3
		MW1-14D	70-80'	3
		MW1-15R	70-80'	3
		MW1-16D	70-80'	3
2 - FPTA No. 1	0	-	-	-
3 - FPTA No. 2	4(2)	MW3-4	20-25'	2
		MW3-5	20-25'	2
		SB3-3	40'MAX	2
		SB3-4	40'MAX	2
4 - FPTA No. 3	8(4)	MW4-4	20-25'	0
		MW4-5	20-25'	2
		MW4-6	20-25'	2
		MW4-4D	70-80'	3
		SB4-4	40'MAX	2
		SB4-5	40'MAX	2
		SB4-6	40'MAX	2
		SB4-7	40'MAX	2
5 - Facility 8550	3(3)	MW5-4	20-25'	2
		MW5-5	20-25'	2
		MW5-6	20-25'	2

**TABLE 2-10**  
**SOIL BORING DETAILS**  
**Scott Air Force Base, Illinois**

Site	No. of Borings <sup>(a)</sup>	Boring I.D	Approximate Depth (gsl)	No. of samples
6 - Facility 1965	5(5)	MW6-8R	40'	2
		MW6-4	30'	2
		MW6-5	30'	2
		MW6-6	30'	2
		MW6-7	30'	2
7 - Sludge Weathering Lagoon	0	-	-	-
8 - Building 1680	0	-	-	-
BG - Background	14(4)	MWB-1	30'	2
		MWB-2	30'	2
		MWB-1D	70-80'	3
		MWB-2D	70-80'	3

° (a) - Figure in parentheses indicates number of monitoring well borings.

TABLE 2-11

**CRITERIA FOR SOIL SAMPLE COLLECTION**  
**Scott Air Force Base, Illinois**

Site	Boring No.	No. of samples	Sampling Criteria
1 - Landfill	MW1-12	0	MW1-17 to MW1-23: One at water table and one at zone with highest PID reading.
	MW1-13	0	
	MW1-14	0	
	MW1-15	0	
	MW1-16	0	
	MW1-17	2	
	MW1-18	2	
	MW1-19	2	MW1-12D to MW1-16D: One at water table, one at zone with highest PID reading, and one at base of boring.
	MW1-20	2	
	MW1-21	2	
	MW1-22	2	
	MW1-23	2	
	MW1-12D	3	
	MW1-13D	3	
	MW1-14D	3	
	MW1-15R	3	
	MW1-16D	3	
2 - FPTA No. 1	0	-	-
3 - FPTA No. 2	MW3-4	2	MW3-4, MW3-5, SB3-3, SB3-4: From the 2 zones with highest PID readings.
	MW3-5	2	
	SB3-3	2	
	SB3-4	2	
4 - FPTA No. 3	MW4-4	0	MW4-5 and MW4-6: One at water table and one at zone with highest PID reading. MW4-4D: as above plus one at base of well.
	MW4-5	2	
	MW4-6	2	
	MW4-4D	3	
	SB4-4	2	SB4-4 to SB4-7: From the 2 zones that exhibit highest head space readings.
	SB4-5	2	
	SB4-6	2	
	SB4-7	2	
5 - Facility 8550	MW5-4	2	MW5-4 to MW5-6: from the two zones that exhibit highest head space readings.
	MW5-5	2	
	MW5-6	2	
6 - Facility 1965	MW6-8R	3	MW6-8R, MW6-4 to MW6-7: From the two zones below the water table that exhibit the highest head space readings.
	MW6-4	2	
	MW6-5	2	
	MW6-6	2	
	MW6-7	2	

**TABLE 2-11**

**CRITERIA FOR SOIL SAMPLE COLLECTION**  
**Scott Air Force Base, Illinois**

<b>Site</b>	<b>Boring No.</b>	<b>No. of samples</b>	<b>Sampling Criteria</b>
7 - Sludge Weathering Lagoon	-	-	-
8 - Building 1680	-	-	-
BG - Background	MWB-1	2	MWB-1, MWB-2 B-10: One immediately below surface and one at water table.
	MWB-1D	3	
	MWB-2	2	MWB-1D, MWB-2D: One immediately below surface, one at water table and one at base of boring
	MWB-2D	3	

2-29

# SOIL TEST BORING RECORD



**LAW ENVIRONMENTAL, INC.**  
**GOVERNMENT SERVICES DIVISION**

JOB NO. \_\_\_\_\_ BORING NO. \_\_\_\_\_  
 JOB NAME \_\_\_\_\_ G.S. ELEV. \_\_\_\_\_  
 DATE: \_\_\_\_\_ HOURS MOVING \_\_\_\_\_  
 WEATHER \_\_\_\_\_ HOURS DRILLING \_\_\_\_\_  
 DRILLER \_\_\_\_\_ PAGE \_\_\_\_\_ OF \_\_\_\_\_

[illegible]

BORING TERMINATED: \_\_\_\_\_  
BORING REFUSAL: \_\_\_\_\_  
WATER TOB DEPTH \_\_\_\_\_  
WATER 24 HR.: DEPTH \_\_\_\_\_  
WATER LOSSES \_\_\_\_\_  
CASING: SIZE \_\_\_\_\_ LENGTH \_\_\_\_\_

## METHOD OF ADVANCING BORING

POWER AUGER  
HAND CHOP: W/MUD: W/WATER  
ROTARY DRILL: W/MUD: W/WATER  
DIAMOND CORE

DEPTH

TO  
TO  
TO  
TO

QA / QC INSTALLED BY: \_\_\_\_\_ CHECKED BY: \_\_\_\_\_ DISCREPANCIES: \_\_\_\_\_

**HF**

- Location (with sketch map)
- Name of drilling contractor
- Drilling method
- Types of drilling fluids and depths at which used
- Diameter of casing, casing type and installation method
- Depth at which saturated conditions are first encountered
- Lithologic descriptions, and depths of lithologic boundaries
- Sample depths
- Zones of caving or heaving
- Drilling fluid losses (depths and amount)
- Changes to drilling fluid properties
- Drilling rate
- Drilling rig reactions (chatter, rod drops, bouncing)

Soil samples will be classified using the Unified Soil Classification System (ASTM-D2488-69). Soil sample descriptions will also include the following information:

- Predominant type of deposit (SAND, CLAY etc.)
- Consistency of cohesive materials or density of non cohesive materials
- Color (using Munsell Soil Color Chart)
- Secondary constituents (i.e., sandy, silty etc.)
- Moisture content (dry, moist, wet)
- Other descriptive features (roots, wood fragments etc.)

A typical soil description will therefore be recorded in the following manner:

CLAY (SC)  
 firm  
 10YR 7/6 Yellow  
 silty  
 moist  
 with wood fragments

Prior to commencement of drilling at each site all site clearance, site preparation and associated activities will be completed in accordance with the requirements described in Section 2.1.1. The drilling rig, augers and all associated equipment will be steam cleaned in accordance with the decontamination requirements described in Section 2.1.9.

Soil borings will be drilled wherever possible using 6.25" I.D continuous flight Hollow Stem Augers. Where Hollow Stem Augering becomes impractical, mud rotary drilling will be used to advance the boring. (Only pure sodium bentonite and potable water will be used for the drilling mud). Soil samples will be collected using a 3" stainless steel split spoon sampler fitted with California brass rings. Samples will be collected continuously for the first ten feet, and then every five feet thereafter to the base of the boring, or at every change in lithology, whichever is less. Samples will be screened using a PID meter, and the results recorded on the soil boring log. A Standard Penetration Test will be conducted each time a sample is collected. The results of the test will be recorded on the Soil Boring Log.

Soil borings for monitoring well installation (i.e., those with the prefix MW in the location code) will be drilled to the depth required for well installation (see Section 2.1.4).

Soil borings which are intended solely for soil sample collection (i.e., those with the prefix SB in the location code) will be drilled below the level of the highest contamination, determined by a steady decrease in PID readings from field screening, or to forty feet below surface, whichever is less.

Two of the borings will be used for the installation of extraction wells for the aquifer tests (MW1-15R and MW6-8R). The larger diameter of the casing to be installed (6" I.D) in these wells will require the use of a different drilling technique. For these borings only, a local private water well drilling contractor with

experience in environmental monitoring well installation will be contracted to install the wells. Drilling and installation will be supervised by a state registered Geologist/Engineer.

#### 2.1.4 Monitoring Well Installation

Monitoring wells will be installed at five of the eight sites in order to obtain ground-water samples and obtain data concerning the hydrological conditions at the sites. The monitoring wells will be installed in a manner which will achieve the following objectives:

- to collect representative ground-water samples;
- to prevent contamination of the aquifer by the drilling equipment; and
- to prevent vertical seepage of surface water into the well intake zone.

Table 2-12 shows the wells to be installed at each of the sites. Figures 2-1 through 2-8 show the locations of the monitoring wells at each site.

Well installation will be conducted by the drilling contractor, under the supervision of a state registered Geologist or Engineer.

2.1.4.1 Monitoring Well Borings - Soil borings for each well will be drilled in accordance with the requirements outlined in Section 2.1.3. The anticipated depths of the borings given in Table 2-10 are approximate and are based on the anticipated depth to the water table or to bedrock. The actual depths of the borings will be determined by the conditions encountered during drilling as follows:



TABLE 2-12

**MONITORING WELL DETAILS**  
**Scott Air Force Base, Illinois**

<b>Site</b>	<b>Shallow Wells</b>	<b>Deep Wells</b>	<b>Recovery Wells</b>
1 - Landfill	MW1-12 MW1-13 MW1-14 MW1-15 MW1-16 MW1-17 MW1-18 MW1-19 MW1-20 MW1-21 MW1-22 MW1-23	MW1-12D MW1-13D MW1-14D MW1-16D	MW1-15R
2 - FPTA No. 1			
3 - FPTA No. 2	MW3-4 MW3-5		
4 - FPTA No. 3	MW4-4 MW4-5 MW4-6	MW4-4D	
5 - Facility 8550	MW5-4 MW5-5 MW5-6		
6 - Facility 1965	MW6-4 MW6-5 MW6-6 MW6-7		MW6-8R
7 - Sludge Weathering Lagoon			
8 - Building 1680			
BG - Background	MWB-1 MWB-2	MWB-1D MWB-2D	

1. Shallow wells (listed in Table 2-12) at Sites 1, 3, 4, 5, and 8 will be installed with a twenty-foot well screen intersecting the water table, with allowances made for short and long term fluctuations. The previous investigation at Scott AFB encountered difficulties in achieving this objective, and in many cases well screens were set below the water table (ERM, 1992). (It is possible that this may have occurred due to the presence of semi-confining clayey layers above the water bearing sandy deposits). In order to attempt to avoid this in this investigation, borings for shallow wells will be drilled to the depth at which saturated conditions are first encountered. The augers will then be withdrawn slightly, and the hole will be allowed to stand for a period of 24 hours to allow the water level in the boring to stabilize. The water level in the augers will be observed after 24 hours, and the well screen will be set so that it intersects this water level.
2. Shallow monitoring wells at Site 6 will be installed in the same manner as described above, except that top of the well screen will be positioned approximately two feet below the surface. This will allow these wells to be used for the vapor extraction test at this site.
3. All deep monitoring wells (listed in Table 2-12) will be installed with a twenty foot well screen situated immediately above the bedrock surface. Borings for these wells will be advanced until auger refusal is reached. The screen will then be set with its base one foot above the base of the boring.
4. Recovery well MW1-15R will be installed with the well screen set immediately above the bedrock surface. The boring for this well will be drilled until auger refusal

is reached (i.e., at bedrock). A thirty-foot well screen with a five-foot sump will then be set one foot above the base of the boring.

5. Recovery well MW6-8R will be installed with the well screen extending from five feet above to approximately twenty-five feet below the water table, with a five-foot sump attached to the base of the screen. This will enable this well to be used for the vapor extraction test as well as for sampling and hydrological testing.
6. In order to allow more accurate positioning of the wells screens in the shallow wells, three pilot borings will be drilled. These borings will be drilled close to existing wells, so that the Static Water levels in these wells can be used as a guide to the position of the water table/piezometric surface. The borings will be used to decide whether or not it will be possible to obtain water samples from the clayey deposits overlying the 'upper sand' layer at the base, or if it will be necessary to screen shallow wells across the clayey deposits and the upper part of the sandy layer in order to obtain samples.

#### 2.1.4.2 Well Construction and Completion -

Well Riser and Screen - In all monitoring wells (shallow and deep), a 2-inch I.D screen and riser will be installed in the boring, using enough sections to extend the riser two to three feet above the ground surface. All monitoring well riser material will consist of new, commercially fabricated, threaded, flush jointed, 2" I.D Type 304 stainless steel pipe. No organic solvents or glues or welding will be used in joining the riser pipe. Well screens will consist of new, commercially fabricated, threaded flush jointed, continuous wrap 2" I.D Type 304 stainless steel pipe. The

well screen in all monitoring wells will be twenty feet long. A threaded stainless steel plug will be threaded into the bottom of the well screen. All well components will be steam cleaned prior to being placed in the hole. Care will be taken when installing the screens, to ensure that the base of the screen sits above any sloughed material in the base of the boring.

In the recovery wells (MW1-15R and MW6-8R), a 6" diameter Type 304 stainless steel riser, screen and sump will be installed in the boring, using enough sections to extend the riser two to three feet above the ground surface. All recovery well riser material will consist of new, commercially fabricated, threaded, flush jointed, 6" I.D Type 304 stainless steel pipe. No organic solvents or glues or welding will be used in joining the riser pipe. Well screens will consist of new, commercially fabricated, continuous wrap, 6" diameter, Type 304, stainless-steel pipe. The well screen in all recovery wells will be thirty feet long. A five-foot sump will be attached to the base of the screen. The sump will consist of new, commercially fabricated, threaded flush jointed, 6" diameter, Type 304, stainless-steel pipe. A threaded, stainless-steel plug will be threaded into the bottom of the well sump. All well components will be steam cleaned prior to being placed in the hole.

For wells which are greater than 50 feet deep, two stainless-steel centralizers will be attached to the well pipe to hold it in the center of the boring while the filter pack is installed. One centralizer will be attached to the top of the well screen and one at the base. Additional centralizers will be used as necessary to hold the well pipe in the center of the boring.

Filter Pack - A filter pack, consisting of clean, inert, well rounded silica sand consisting of less than 2% flat particles will be installed in the annular space between the stainless steel screen and the boring wall, from the base of the boring to at least two feet above the top of the screen in each well. A 20/30 type of

sand will be used; this should be appropriate for the conditions that will be encountered at Scott AFB, based on the types of materials encountered during the previous investigation at the base. The sand will be tremied into the annulus using a tremie pipe. The sand will be continuously tamped to prevent bridging. The depth of the sand pack and the amount of sand used will be continuously monitored. After the filter pack has been installed to a level of at least two feet above the top of the screen, the well will be surged for ten minutes using a surge block. Additional sand will then be added to bring the level back up to two feet above the screen. The well will then be surged for an additional five minutes. More sand will then be added if necessary to return the level of the sand to two feet above the screen.

Bentonite Seal - A bentonite seal will be installed above the filter pack in each well. Bentonite slurry will be fed into position above the filter pack using a tremie pipe, so that a seal at least two feet thick is formed. At least eight hours will be allowed to elapse prior to grouting to allow time for the bentonite to properly hydrate.

Well Plumbness - All wells will be checked for plumbness after installation. A ten-foot length of pipe, one half-inch less in diameter than the I.D of the riser pipe, will be run through the entire length of the well. This pipe section will be steam cleaned prior to use at each location. If the pipe does not run freely through the full length of the well, the well will be replaced or repaired.

Grout Seal - A cement grout seal will be placed into the annular space between the stainless steel riser and the boring wall from the top of the bentonite seal to the ground surface. Grout will be emplaced using a tremie pipe and pump. The grout mix will consist of Type I Ordinary Portland Cement or American Petroleum Institute (API) Grade A Cement, and water added in the proportion of not less

than five to not more than eight gallons of water per 94-pound bag of cement. Up to four pounds of pure sodium bentonite per bag of cement will be added to the mixture to help reduce shrinkage. The grout will be poured in one continuous operation to avoid the formation of cold joints. Pumping will continue until 20 percent of the grout has been returned to the surface. At least 40 hours will be allowed to elapse prior to development in order to allow the grout to fully cure.

Well Completion - Wells will be completed at surface with either a flush mount or an aboveground completion, depending on the location of the well. Flush mount completions will be used in high traffic areas where the risk of damage to an aboveground completion would be too great, or where an aboveground completion would cause an obstruction.

For flush-mounted completions the riser casing will be cut off approximately three inches below ground surface. A watertight casing cap will be used to prevent surface water from running into the well. A freely draining valve box with a lockable cover will be placed over the casing. The top of the casing will be at least one foot above the bottom of the box. The valve box lid will be centered in a three-foot diameter concrete pad, which slopes outward away from the box, and which extends below the frost line. The identity of the well will be permanently marked on the casing cap and on the valve box lid.

For aboveground completions, the riser casing will not be cut. If necessary, additional riser will be added so that the top of the riser is two to three feet above the ground surface. A lockable watertight casing cap will be placed in each well. A steel sleeve with a lockable lid will be placed over the well riser and will be embedded in a two-foot by four-foot concrete pad which slopes away from the well and which is of sufficient thickness to extend below the frost line. The sleeve diameter will be at least six inches

greater than the well riser diameter. The identity of the well will be permanently marked on the casing cap and on the protective sleeve. A brass surveying disc will be set into the concrete pad at each well.

Three 3-inch diameter, concrete filled, steel guard posts will be installed around wells with aboveground completions where there is a significant risk of damage by vehicles, etc. The guard posts will be five feet in length and will be embedded at least two feet into the ground and set in concrete. The posts will not be set in the concrete pad around the well. The protective sleeve and the posts will be painted with a color to be specified by the base civil engineer.

All wells will be fitted with corrosion-resistant locks. The locks will be keyed alike. Lock keys will be given to the base point of contact on completion of the field effort. Special flood plain surface completions may be required for wells located downgradient of the landfill.

Well Completion Diagrams - A Type II Well Installation diagram will be completed for each well installed (see Figure 2-10). The diagram will include the following information:

- Project Name, Number and Well Number
- Date and time of start and completion of well installation
- Well location
- Ground surface elevation
- Top of screen elevation
- Riser material, manufacturer, diameter and length
- Screen material, manufacturer, diameter, size and length
- Drilling Technique
- Bentonite type and manufacturer
- Cement type and manufacturer

FIGURE 2-10

# TYPE II MONITORING WELL INSTALLATION DIAGRAM

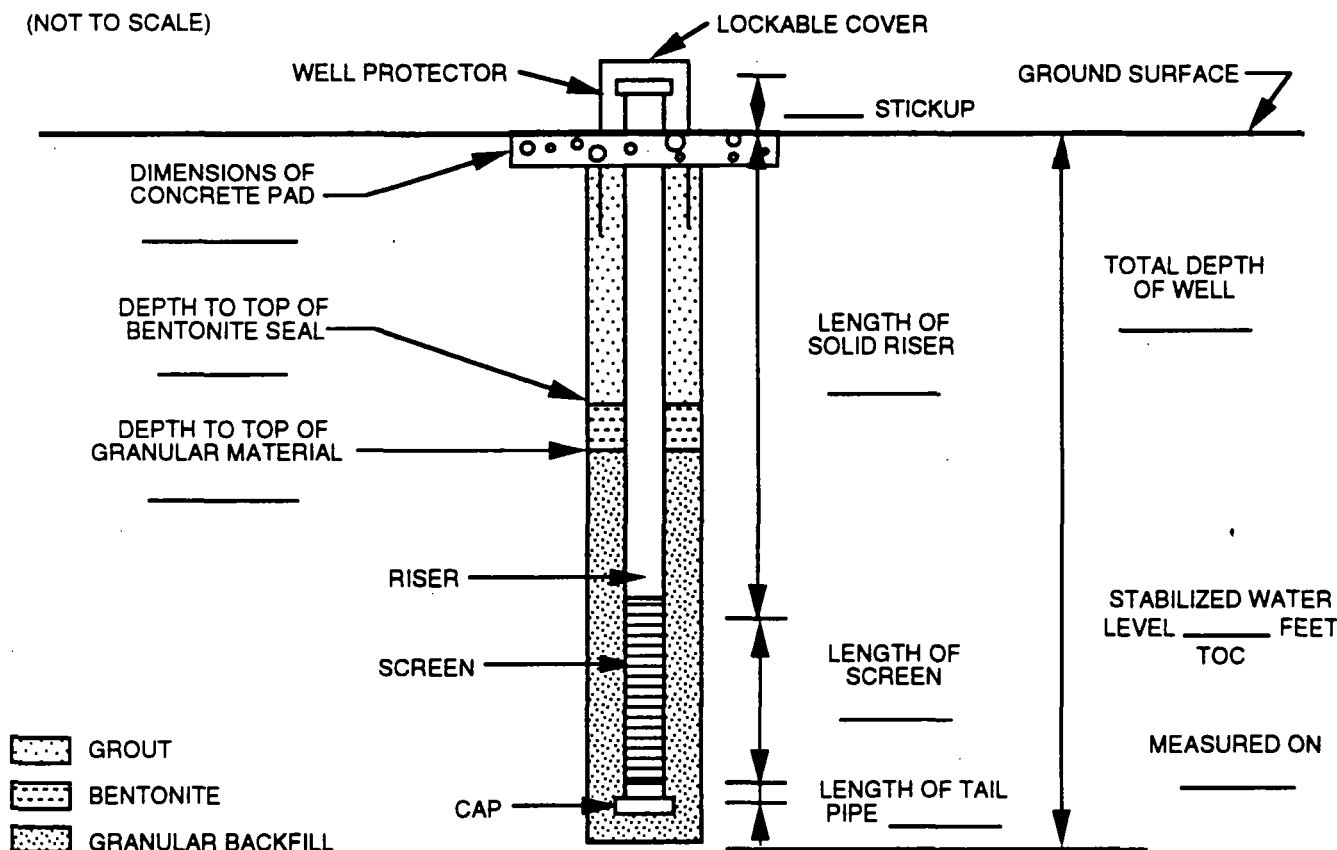


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JOB NAME \_\_\_\_\_  
WELL NO. \_\_\_\_\_ JOB NO. \_\_\_\_\_  
DATE \_\_\_\_\_ TIME \_\_\_\_\_  
WELL LOCATION \_\_\_\_\_

GROUND SURFACE ELEVATION _____	BENTONITE TYPE _____
TOP OF SCREEN ELEVATION _____	MANUFACTURER _____
REFERENCE POINT ELEVATION _____	CEMENT TYPE _____
TYPE SAND PACK _____ GRADATION _____	MANUFACTURER _____
SAND PACK MANUFACTURER _____	BOREHOLE DIAMETER _____
SCREEN MATERIAL _____	SCREEN DIAMETER _____ SLOT SIZE _____
MANUFACTURER _____	LAW ENVIRONMENTAL, INC.
RISER MATERIAL _____	FIELD REPRESENTATIVE _____
MANUFACTURER _____	DRILLING CONTRACTOR _____
RISER DIAMETER _____	AMOUNT BENTONITE USED _____
DRILLING TECHNIQUE _____	AMOUNT CEMENT USED _____
AUGER SIZE AND TYPE _____	AMOUNT SAND USED _____
REMARKS _____	STATIC WATER DEPTH (after dev.) _____

(NOT TO SCALE)



**QA / QC**

INSTALLED BY: \_\_\_\_\_ INSTALLATION OBSERVED BY: \_\_\_\_\_  
DISCREPANCIES: \_\_\_\_\_



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- Borehole diameter
- Amount of bentonite, sand and cement used
- Static water level before and after development
- Total well depth
- Depth to top of filter pack
- Depth to top of bentonite seal
- Well stick-up
- Details of any discrepancies

2.1.4.3 Monitoring Well Development - All wells will be developed no sooner than forty-eight hours after grouting is completed. Development protocol will be as follows:

- 1) Measure the static water level in the well using an interface probe, capable of detecting both petroleum products and water levels.
- 2) Measure the total well depth
- 3) Develop the well using a combination of surging, bailing and pumping. Begin by surging the well with a surge block for a period of not less than fifteen minutes. Then use either a bailer or a pump to evacuate the well. Continue pumping/bailing and periodically surging until:
  - 1) the suspended sediment content of the water is less than 0.75 mL/L as measured in an Imhoff Cone according to Method E160.5;
  - 2) the turbidity remains within a ten nephelometric turbidity unit (NTU) range for at least 30 minutes; and
  - 3) the temperature, pH and conductivity have stabilized. Stabilization criteria are as follows: temperature  $\pm 1$  degree C, pH  $\pm 0.2$  units, conductance  $\pm 5\%$ .

- 4) All fluids introduced to the well will be removed during development. Therefore in addition to the above criteria at least three times the total quantity of fluids added during drilling will be removed during development.
- 5) In the event that the well goes dry during development, then the well will be considered developed after it has been bailed dry three times; enough time will be allowed each time for the well to fully recharge.
- 6) Physical characteristics of the water will be recorded throughout the development operation (color, odor, turbidity).
- 7) The total quantity of water removed will be recorded
- 8) The static water level in the well will be recorded at least 24 hours after the completion of development. Total well depth will also be recorded at this time.
- 9) After development is completed a one-liter sample of the water from the well will be collected in a clear glass jar. The jar will be labelled and then photographed. The photo will be suitably backlit to show the clarity of the water.

Well development data will be recorded on a Monitoring Well Development Form, (Figure 2-11).

#### 2.1.5 Hydropunch/Soil Borings

The Hydropunch system will be used in conjunction with a conventional drilling rig to collect soil and ground-water samples

FIGURE 2-11



**LAW ENVIRONMENTAL, INC.**  
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JOB NAME \_\_\_\_\_ JOB No. \_\_\_\_\_

BY \_\_\_\_\_ CHECKED \_\_\_\_\_ SHEET \_\_\_\_\_ OF \_\_\_\_\_

**WELL DEVELOPMENT DATA**

1. Well No. \_\_\_\_\_
  2. Date of Installation : \_\_\_\_\_
  3. Date of Redevelopment : \_\_\_\_\_
  4. Static Water Level : Before Development \_\_\_\_\_ ft.: 24 Hours After \_\_\_\_\_ ft
  5. Quantity of Water Loss During Drilling, If Used \_\_\_\_\_ Gal.
  6. Quantity of Standing Water in Well and Annulus Before Development \_\_\_\_\_ Gal.
- |                                 | <u>Start</u> | <u>During</u> | <u>End</u> |
|---------------------------------|--------------|---------------|------------|
| 7. Physical Appearance          | _____        | _____         | _____      |
| Specific Conductance (umhos/cm) | _____        | _____         | _____      |
| Temperature (c°)                | _____        | _____         | _____      |
| pH (s.u.)                       | _____        | _____         | _____      |
8. Depth From Top of Well Casing to Bottom of Well \_\_\_\_\_ ft.
  9. Screen Length \_\_\_\_\_ ft.
  10. Depth to Top of Sediment : Before Development \_\_\_\_\_ ft.; After Development \_\_\_\_\_ ft.
  11. Type and Size of Well Development Equipment : \_\_\_\_\_  
\_\_\_\_\_
  12. Description of Surge Technique, If Used : \_\_\_\_\_  
\_\_\_\_\_
  13. Height of Well Casing Above Ground Surface : \_\_\_\_\_ ft.
  14. Quantity of Water Removed : \_\_\_\_\_ Gal. Time for Removal : \_\_\_\_\_ Hr./Min.
  15. 1-Liter Water Sample Collected : \_\_\_\_\_ (Time)
  16. Turbidity in Nephelometric Units \_\_\_\_\_ NTUs

\*Development Conditions : 1) Well Water If Reasonably Clear  
2) Sediment Thickness 5% of Screen Length  
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus  
4) Stabilization of Specific Conductance and Water Temperature



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at Site 6. The intent of this activity is to conduct an initial evaluation of the nature and extent of ground-water and soil contamination and to provide data which can be used to select monitoring well locations. The Hydropunch tool will be pushed without drilling at Sites 4 and 5 to collect ground-water samples. This data will also be used as a field screening procedure to evaluate the nature and extent of ground-water contamination.

At Site 4 the system will be used to collect ground-water samples at thirty locations (HP4-1 through HP4-30). These locations will initially be as shown on Figure 2-4, however actual locations may vary due to access problems and the requirement to delineate the extent of contamination. The Hydropunch sampling tool will be pushed below the water table to collect a sample of ground water. A field GC (Gas Chromatograph) will be used to determine the volatile content of each sample. The results of the field GC analyses will be used to select monitoring well locations.

At Site 5, Hydropunch will be used to collect samples at 30 locations (HP5-1 through HP5-30). Locations will initially be as indicated on Figure 2-5, but may vary due to access difficulties and the requirement to delineate the extent of the contamination. The Hydropunch sampling tool will be pushed below the water table to collect a sample of ground water. The shallow depth of the water table at this site may make it difficult to collect some of the samples. If this is the case then samples will be collected from the minimum possible depth at which the sample chamber will fill. A field GC (Gas Chromatograph) will be used to determine the volatile content of each sample. The results of the field GC analyses will be used to select monitoring well locations.

At Site 6, field screening will be conducted at twenty locations, using the Hydropunch system in conjunction with a conventional drilling rig and a Field GC (Gas Chromatograph), (HP6-1 through

HP6-20). Locations will be as indicated on Figure 2-7, but may vary due to access difficulties and the requirement to delineate the extent of the plume. At each location a soil boring will be drilled to the water table using 6.25" Hollow Stem Augers. The anticipated depth of the soil borings is two to six feet. Two soil samples will be collected from each boring using a Split Spoon Sampler fitted with California Brass Rings for collection of samples for volatile analysis. Samples will be collected from the two zones which exhibit the highest head space reading on the PID meter. The Hydropunch system will then be used to collect ground-water samples at each location. Each sample will be analyzed for volatile contamination using the Field GC. The six samples which exhibit the highest volatile content will be sent to Law Environmental National Laboratories (LENL) in Pensacola, Florida for analysis.

#### 2.1.6 Aquifer Testing

Two different types of aquifer test will be conducted as part of the investigation. At Site 1 - (Landfill) and at Site 6 - (Facility 1965 Spill Site), pumping tests will be performed. At Site 4 - (Fire Protection Training Area No. 3), slug/bail tests will be conducted.

Pumping Tests - Pumping tests will be conducted at Sites 1 and 6. The objectives of these tests are to: 1) estimate the hydraulic properties of the aquifer; 2) estimate the potential yield of the aquifer; 3) estimate the degree of interconnection between the shallow and deep zones of the aquifer; 4) test for the anisotropy and homogeneity of the aquifer; and 5) check for boundary effects.

Prior to starting the pumping tests, an 8 hour step drawdown test will be performed in the pump test well at each site. Data from this test will be used to determine the maximum sustainable pumping rate for the 24-hour pump tests.

Each pump test will involve the pumping of a 6" diameter, Type II well with a 30' screen (MW1-15R at Site 1, MW6-8R at Site 6). Aquifer response will be monitored by a network of monitoring wells. The pump test wells will be designed to allow for sustained pumping rates as high as 50 gallons per minute (gpm).

During the pump tests, water levels in a well located outside the radius of influence of the test will be monitored to evaluate how external influences affect water levels. External influences commonly include changes in barometric pressure and infiltration due to rainfall. A baroprobe will be used to continuously record atmospheric pressure during the tests.

The pumping tests will be performed using an electrical submersible pump. Pumping rate will be gauged continuously during the tests, and will be adjusted, as required, to maintain a uniform rate. A portable generator and floodlights will be set up at each of the sites.

Methods of analysis for the pump test data will likely include the Neuman Procedures for unconfined aquifers and the Theis recovery analysis for confined aquifers. The Theis results will be used as a secondary check on the Neuman Solution results. The Aqtesolv software package will be used during data reduction. Analysis will be conducted in accordance with "Analysis and Evaluation of Pumping Test Data" (Kruseman and De Ridder, 1991).

Drawdown induced in the aquifer will be measured by transducers placed in each monitoring well at the pump test site. An In-Situ

Inc. SE 2000 Hydrologic Monitor (or equivalent) will be used to monitor and record the decreasing water levels during the tests. Data which is determined to be invalid will be removed from the pump test results.

Pump test waters will be collected, tested and disposed of according to regulatory requirements. It is estimated that approximately 100,000 gallons of water will require treatment after each test.

Slug/Bail Tests - Four aquifer (slug/bail) tests will be performed at Site 4, in monitoring wells MW4-4, MW4-4D, MW4-5 and MW4-6. This type of test will provide values for the hydraulic conductivity, transmissivity and storage coefficient for the surficial deposits in the immediate vicinity of the well screen in each well. The purpose of conducting these tests is to provide a more accurate determination of the hydrogeologic conditions which exist at the site, to assist in determining suitable remediation options and in evaluating probable migration rates for suspected ground-water contaminants. The tests will be conducted using a downhole pressure transducer linked to an In Situ Inc. SE 2000 Hydrologic Monitor. Data reduction will be conducted using the Aqtesolv software package. The Bouwer and Rice method will be used for data interpretation.

#### 2.1.7 Vapor Extraction Testing

A soil vapor extraction test will be performed at Site 6. The objectives of this test are as follows:

- evaluate the flow of air that can be extracted from the wells vs vacuum required.
- evaluate the radius of influence of the vacuum produced by the system.

- determine the type and concentrations of VOCs in the effluent air stream using an OVA and a laboratory gas chromatograph/mass spectrometer (GC/MS).
- develop a concentration vs. time trend for the VOCs in the effluent air stream.
- estimate the pounds per day of VOCs that can be removed from the subsurface.

The test will be conducted using the recovery well MW6-8R, which will be connected to the vapor extraction system.

#### 2.1.8 Surveying

Upon completion of the wells, a survey crew will locate by standard surveying methods, each new monitoring well, soil boring, and sampling location. A vertical survey will be conducted to establish the elevation of each permanent monitoring well. Vertical control will be to the National Geodetic Vertical Datum. The horizontal grid coordination of each location will be recorded to an accuracy of  $\pm 0.1'$ . The vertical elevation of monitoring wells will be established to within  $\pm 0.01'$ . The survey will be tied to the base coordinate system.

#### 2.1.9 Equipment Decontamination

All downhole drilling tools will be steam cleaned and washed with Alconox prior to commencement of each boring. Split Spoon Samplers will be cleaned after each use with Alconox and water, rinsed twice with potable water, rinsed once with deionized water, and then with spray rinses containing spectroscopic grade methanol and pesticide grade hexane before being allowed to air dry on a clean surface (aluminum foil or clean PVC sheeting). All decontamination



solutions will be containerized in drums and will be subject to the same waste handling requirements as other liquid wastes (see 2.1.10).

#### 2.1.10 Waste Handling

All drill cuttings will be containerized in clean, Department of Transport (DOT) approved drums. All drums of soil will be moved to a staging area to be designated by the base. All drums will be suitably and permanently labelled with the project name (Scott AFB), the location (i.e., MW1-12), the date, the contents of the drum (soil), and the name of the base Point of Contact. If existing analytical results warrant it, one composite sample of the soil cuttings from each site will be taken for TCLP analysis. The method of disposal of the drums will be decided on the basis of these results.

Development water, decontamination water, and purge water will also be containerized in DOT approved drums, suitably labelled and moved to a central staging area. The method of disposal will be decided once the analytical results for ground-water samples from each well become available.

A separate drum will be provided at each site for the disposal of such items as Tyvek, gloves etc.

#### 2.1.11 Field Task Summary

Tables 2-1 through 2-9 provide a summary of the field tasks which will be conducted at each of the eight sites and at the background location for this investigation.

## 2.2 ENVIRONMENTAL SAMPLING

Field sampling activities include the collection of ground-water, surface water, sediment and soil boring samples. The collection methods, including sample handling, sample custody, QC samples, and sample analysis are presented in the following subsections.

### 2.2.1 Procedures for Collection of Samples

This section presents the planned program for collection of samples for chemical analysis. The following sections present the site-specific sampling requirements, the planned sample collection procedures, and the procedures to be used to maintain sample integrity.

Prior to all sampling, a field laboratory will be established. The laboratory will contain all equipment, supplies, safety gear, and instrumentation necessary for the collection of samples. Table 2-13 provides a checklist for field equipment.

Prior to sampling, field instruments will be calibrated, files containing sample information will be processed and labels will be prepared. Sample bottles will be sorted for each sample location according to analyses.

Environmental conditions will also be characterized. Each sampling site will be characterized by the following criteria.

1. Location of work
2. Weather
3. Rainfall
4. Temperature - minimum and maximum
5. Wind direction

**TABLE 2-13**

**FIELD EQUIPMENT CHECKLIST**  
**Scott Air Force Base, Illinois**

**General**

- \_\_\_\_\_ 1. Investigation Work Plan
- \_\_\_\_\_ 2. Sampling and Analysis Plan (includes Quality Assurance Project Plan and Field Sampling Plan)
- \_\_\_\_\_ 3. Health and Safety Plan
- \_\_\_\_\_ 4. Site base map
- \_\_\_\_\_ 5. Hand calculator
- \_\_\_\_\_ 6. Brunton compass
- \_\_\_\_\_ 7. Personal clothing and equipment

**Safety Equipment**

- \_\_\_\_\_ 1. Work gloves
- \_\_\_\_\_ 2. Barrier rope
- \_\_\_\_\_ 3. Plastic flagging tape
- \_\_\_\_\_ 4. Drinking water container
- \_\_\_\_\_ 5. Gatorade or equivalent
- \_\_\_\_\_ 6. First aid kit
- \_\_\_\_\_ 7. Eyewash kit
- \_\_\_\_\_ 8. Spill control (Vermiculite)

**Personal Protective Equipment**

- \_\_\_\_\_ 1. Long cotton underwear
- \_\_\_\_\_ 2. Coveralls, cotton
- \_\_\_\_\_ 3. Coveralls, Tyvek
- \_\_\_\_\_ 4. Surgical gloves
- \_\_\_\_\_ 5. Protective gloves (polypropylene/nitrile/viton)
- \_\_\_\_\_ 6. Protective boots (rubber, steel toe/shank)
- \_\_\_\_\_ 7. Hard hat
- \_\_\_\_\_ 8. Face shield
- \_\_\_\_\_ 9. Safety glasses
- \_\_\_\_\_ 10. Air-purifying respirator
- \_\_\_\_\_ 11. Respirator spectacle kit

**Environmental Monitoring Equipment**

- \_\_\_\_\_ 1. Shovels
- \_\_\_\_\_ 2. Keys to well caps
- \_\_\_\_\_ 3. pH meter (with calibrating solutions)
- \_\_\_\_\_ 4. pH paper
- \_\_\_\_\_ 5. Thermometer
- \_\_\_\_\_ 6. Conductivity meter (with calibrating solution)
- \_\_\_\_\_ 7. Organic vapor analyzer or photoionization detector with calibration gas
- \_\_\_\_\_ 8. Explosimeter
- \_\_\_\_\_ 9. Oxygen meter

TABLE 2-13

**FIELD EQUIPMENT CHECKLIST**  
**Scott Air Force Base, Illinois**

Sampling Equipment

- |       |     |   |
|-------|-----|---|
| _____ | 1.  | Tool box with assorted tools (pipe wrenches, screwdrivers, socket set and driver, open and box end wrenches, hacksaw, hammer, vise grips) |
| _____ | 2.  | Geologic hammer   |
| _____ | 3.  | Trowel  |
| _____ | 4.  | Stainless steel and/or Teflon spatula   |
| _____ | 5.  | Hand auger  |
| _____ | 6.  | Dames & Moore Type U split-spoon sampler with liners (stainless steel, brass)   |
| _____ | 7.  | Engineer's tape   |
| _____ | 8.  | Steel tape  |
| _____ | 9.  | Electric water level sounder  |
| _____ | 10. | Petroleum interface probe   |
| _____ | 11. | Batteries   |
| _____ | 12. | Bailers (Teflon, stainless steel, acrylic, PVC)   |
| _____ | 13. | Slug test water displacement tube   |
| _____ | 14. | Vacuum hand pump  |
| _____ | 15. | Electric vacuum pump  |
| _____ | 16. | Displacement hand pump  |
| _____ | 17. | Mechanical pump (centrifugal, submersible, bladder)   |
| _____ | 18. | Portable generator  |
| _____ | 19. | Gasoline for generator  |
| _____ | 20. | Hose  |
| _____ | 21. | Calibrated buckets  |
| _____ | 22. | Stop watch  |
| _____ | 23. | Orifice plate or equivalent flow meter  |
| _____ | 24. | Data logger and pressure transducers  |
| _____ | 25. | Sample bottles  |
| _____ | 26. | Sample preservatives (nitric, hydrochloric, sodium hydroxide)   |
| _____ | 27. | Heavy-duty aluminum foil  |
| _____ | 28. | Coolers   |
| _____ | 29. | Ice (not reusable ice packs ["Blue Ice"])   |
| _____ | 30. | Large "Ziploc" freezer bags   |
| _____ | 31. | Miscellaneous garbage bags  |
| _____ | 32. | Duct tape   |
| _____ | 33. | Strapping tape  |
| _____ | 34. | Paper towels  |
| _____ | 35. | "Bubble" pack   |
| _____ | 36. | Vermiculite   |
| _____ | 37. | Clear tape  |
| _____ | 38. | Containers for field tests (pH, SC, temp.)  |
| _____ | 39. | Transfer pipets (glass) and bulbs   |
| _____ | 40. | Polyethylene rope for bailers   |
| _____ | 41. | Teflon tubing to cover bailer rope  |

**TABLE 2-13**

**FIELD EQUIPMENT CHECKLIST**  
**Scott Air Force Base, Illinois**

Decontamination Equipment

- \_\_\_\_\_ 1. Potable water
- \_\_\_\_\_ 2. Alconox, Liquinox, or equivalent
- \_\_\_\_\_ 3. Methanol, pesticide-grade
- \_\_\_\_\_ 4. Hexane, pesticide-grade
- \_\_\_\_\_ 5. Nitric acid
- \_\_\_\_\_ 6. Distilled, deionized water, reagent or HPLC-grade
- \_\_\_\_\_ 7. Teflon squeeze bottles
- \_\_\_\_\_ 8. Stainless steel garden sprayers
- \_\_\_\_\_ 9. Buckets and containers for decontamination fluids
- \_\_\_\_\_ 10. Scrub and bottle brushes
- \_\_\_\_\_ 11. Waste containers (plastic trash cans/55-gallon hazardous waste containment drums)
- \_\_\_\_\_ 12. Steam cleaner (generally provided by subcontractor)

Documentation Supplies

- \_\_\_\_\_ 1. Field log book
- \_\_\_\_\_ 2. Daily quality control report
- \_\_\_\_\_ 3. Soil test boring record
- \_\_\_\_\_ 4. Monitoring well installation log forms
- \_\_\_\_\_ 5. Well development data forms
- \_\_\_\_\_ 6. Field sampling report
- \_\_\_\_\_ 7. Aquifer test data forms
- \_\_\_\_\_ 8. Sample chain-of-custody log forms
- \_\_\_\_\_ 9. Custody seals
- \_\_\_\_\_ 10. Cooler labels ("This side up," "Hazardous Material," "Fragile")
- \_\_\_\_\_ 11. Federal Express/DHL labels
- \_\_\_\_\_ 12. Request for analysis form
- \_\_\_\_\_ 13. Sample bottle labels
- \_\_\_\_\_ 14. Camera and film
- \_\_\_\_\_ 15. Paper
- \_\_\_\_\_ 16. Pens/pencils
- \_\_\_\_\_ 17. Felt tip markers (indelible ink)

6. Ongoing activities that may influence or disrupt sampling efforts.
7. Accessibility to the sampling locations, e.g. rough terrain, fallen trees, flooding, etc.

These criteria will be recorded in the field sampling books and used to assess sampling procedures in relation to the sample data.

The field team leader will brief the sampling team on safety, decontamination stations and any other sampling protocols necessary. Each sampling team member will wear the appropriate level of safety gear.

2.2.1.1 Ground-Water Sampling - Ground-water samples will be collected from newly-installed wells and existing wells at Scott AFB. Table 2-14 lists the samples taken from each site.

2.2.1.1.1 Sampling Equipment - Ground-water samples will be obtained with cleaned and dedicated teflon bailers or dedicated purge and bladder pumps. Bailers will be cleaned as outlined in Section 2.3.4. After the bailer has air-dried it will be wrapped in aluminum foil to prevent contamination. Polyethylene rope will be used to lower the bailer into the well. The portion of the rope that enters the water will be covered with teflon tubing. If dedicated bladder pumps are used, the monitoring wells will be purged and sampled with the bladder pump. The bladder pump will be placed in the screened interval of the well. Figure 2-12 illustrates the pump system.

2.2.1.1.2 Sampling Protocol - Ground-water sampling will be conducted in a manner which minimizes interaction of the sample and the surface environment.

TABLE 2-14

**GROUND-WATER AND SURFACE WATER SAMPLES**  
**Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>BACKGROUND:</b>	MWB-1	3*
	MWB-1D	3*
	MWB-2	3*
	MWB-2D	3*
	SWB-1	3*
	SWB-2	1
	SWB-3	1
<b>LANDFILL:</b>	MW1-12	1
	MW1-12D	1
	MW1-13	1
	MW1-13D	1
	MW1-14	1
	MW1-14D	1
	MW1-15	1
	MW1-15R	1
	MW1-16	1
	MW1-16D	1
	MW1-17	1
	MW1-18	1
	MW1-19	1
	MW1-20	1
	MW1-21	1
	MW1-22	1
	MW1-23	1
	MW1-4	1
	MW1-7	1
	MW1-9	1
	MW1-10S	1
	MW1-10D	1
	MW1-11	1
	SW1-7	1
	SW1-8	1
	SW1-9	1
	SW1-10	1
	SW1-11	1
<b>FPTA No. 1:</b>	No water samples collected.	

**TABLE 2-14**

**GROUND-WATER AND SURFACE WATER SAMPLES  
Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>FPTA No. 2:</b>	MW3-2	1
	MW3-3	1
	MW3-4	1
	MW3-5	1
<b>FPTA No. 3:</b>	MW4-1	1
	MW4-2	1
	MW4-4	1
	MW4-4D	1
	MW4-5	1
	MW4-6	1
	HP4-1	1
	HP4-2	1
	HP4-3	1
	HP4-4	1
	HP4-5	1
	HP4-6	1
	HP4-7	1
	HP4-8	1
	HP4-9	1
	HP4-10	1
	HP4-11	1
	HP4-12	1
	HP4-13	1
	HP4-14	1
	HP4-15	1
	HP4-16	1
	HP4-17	1
	HP4-18	1
	HP4-19	1
	HP4-20	1
	HP4-21	1
	HP4-22	1
	HP4-23	1
	HP4-24	1
	HP4-25	1
	HP4-26	1



TABLE 2-14

**GROUND-WATER AND SURFACE WATER SAMPLES**  
**Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>FPTA No. 3 (continued):</b>	HP4-27	1
	HP4-28	1
	HP4-29	1
	HP4-30	1
<b>FACILITY 8550:</b>	MW5-4	1
	MW5-5	1
	MW5-6	1
	SW5-1	1
	SW5-2	1
	SW5-3	1
	SW5-4	1
	SW5-5	1
	HP5-1	1
	HP5-2	1
	HP5-3	1
	HP5-4	1
	HP5-5	1
	HP5-6	1
	HP5-7	1
	HP5-8	1
	HP5-9	1
	HP5-10	1
	HP5-11	1
	HP5-12	1
	HP5-13	1
	HP5-14	1
	HP5-15	1
	HP5-16	1
	HP5-17	1
	HP5-18	1
	HP5-19	1

TABLE 2-14

**GROUND-WATER AND SURFACE WATER SAMPLES  
Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>FACILITY 8550 (continued):</b>	HP5-20	1
	HP5-21	1
	HP5-22	1
	HP5-23	1
	HP5-24	1
	HP5-25	1
	HP5-26	1
	HP5-27	1
	HP5-28	1
	HP5-29	1
	HP5-30	1
<b>FACILITY 1965:</b>	HP6-1	1
	HP6-2	1
	HP6-3	1
	HP6-4	1
	HP6-5	1
	HP6-6	1
	HP6-7	1
	HP6-8	1
	HP6-9	1
	HP6-10	1
	HP6-11	1
	HP6-12	1
	HP6-13	1
	HP6-14	1
	HP6-15	1
	HP6-16	1
	HP6-17	1
	HP6-18	1
	HP6-19	1
	HP6-20	1
	MW6-8R	1
	MW6-7	1

TABLE 2-14

**GROUND-WATER AND SURFACE WATER SAMPLES**  
**Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>FACILITY 1965 (continued):</b>	MW6-6	1
	MW6-5	1
	MW6-4	1
	MW6-2	1
<b>SLUDGE WEATHERING LAGOON:</b>	HP7-1	1
	HP7-2	1
	HP7-3	1
	HP7-4	1
	HP7-5	1
	HP7-6	1
	HP7-7	1
	HP7-8	1
	HP7-9	1
	HP7-10	1
	HP7-11	1
	HP7-12	1
	HP7-13	1
	HP7-14	1
	HP7-15	1
	HP7-16	1
	HP7-17	1
	HP7-18	1
	HP7-19	1
	HP7-20	1
	SW7-1	1
	SW7-2	1
	SW7-3	1
	SW7-4	1

**TABLE 2-14**

**GROUND-WATER AND SURFACE WATER SAMPLES  
Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>BUILDING 1680:</b>	No further sampling required.	-

NOTE: Wells MW1-4, MW1-7, MW-19, MW1-10S, MW1-10D, MW1-11, MW3-2, MW3-3, MW4-1, MW4-2 and MW6-2 are existing wells that will be sampled.

MW = Monitoring Well

SW = Surface Water

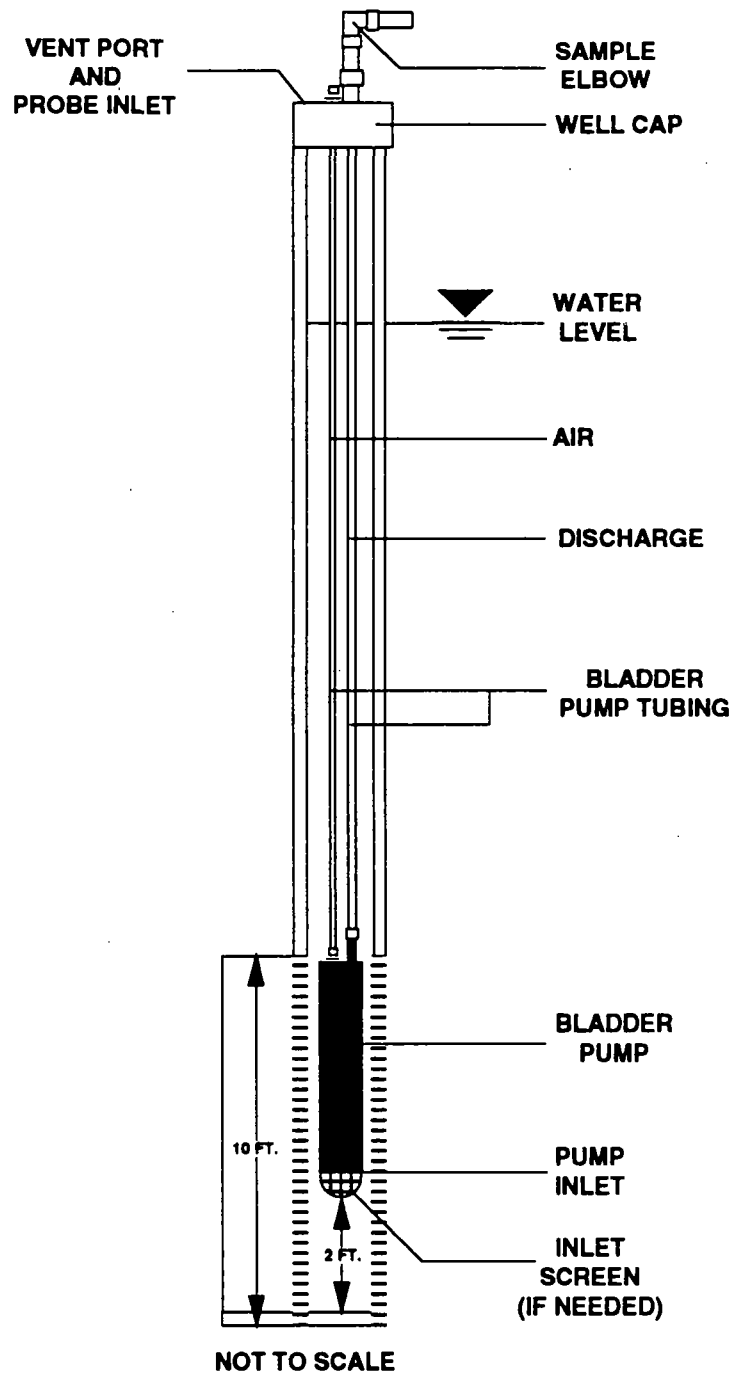
HP = Hydropunch

\* = One sample taken for each of three sampling events.

FIGURE 2-12

# DEDICATED WELL SYSTEM BLADDER PUMP

REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
SCOTT AFB, ILLINOIS



The sampling protocol at Scott AFB will be as follows:

- a. Floating Hydrocarbon Measurement - An electronic interface probe will be used to test for the presence of floating product in the newly-installed and existing wells. The probe will be lowered into the wellbore and if product is present, its thickness will be recorded. Its presence will be confirmed by withdrawing a sample. The probe will be decontaminated after each use by the protocol described in subpart b.
- b. Measure Water Level - An electronic water level indicator will be used to measure the static water level in the well prior to purging. The water level probe will be lowered into the wellbore and the water level will be recorded. The volume of water in the wellbore and filter pack will be calculated using the equation in subpart c.

Decontamination of the probe will be performed to minimize the potential for cross-contamination between wells. As the probe is being withdrawn from the well, the following procedure will be used for decontamination:

- 1) Hand wash the calibrated tape and probe with bristle brush and a solution of Alconox (or equivalent);
- 2) Rinse with copious quantities of potable water;
- 3) Rinse with deionized (Reagent Grade II) water;
- 4) Spray-rinse with pesticide grade methanol;
- 5) Spray-rinse with pesticide grade hexane;
- 6) Air dry.

The water level indicator will be cleaned thoroughly using this method between each wellbore.

- c. Purge the well with the teflon bailer or purge pump until the pH, specific conductance, and temperature have stabilized within  $\pm 0.2$  pH units,  $\pm 5$  percent, and  $\pm 1$  degree C respectively. Remove a minimum of three fluid casing volumes, checking the above mentioned parameters after each casing volume is removed. If, after three fluid casing volumes have been removed, the parameters have not been stabilized, remove well casing volumes until the parameters stabilize or until six volumes have been purged. If the well bails dry and does not recharge within a reasonable time to permit three volumes to be removed, record the volume removed and sample as soon as sufficient recharge has occurred. The calculation for well volume is presented below:

CALCULATING WATER VOLUME

VOLUME OF WATER IN WELL

$$H_1 \Pi 7.48 [(R_1^2 - R_2^2) \cdot \phi + R_2^2]$$

Volume of hole with sand pack	Volume of PVC with sand pack
-------------------------------------	------------------------------------

$H_1$  = height of water in well screen and sand pack in feet

$r_1$  = radius of borehole in feet

$r_2$  = radius of PVC in feet

7.48 = amount of water in 1 cubic ft.

$\phi$  = porosity of sand pack

- d. Label Sample - Label the sample bottle as outlined in Section 2.2.2.
- e. Collect Sample - Ground-water sampling will be conducted by using dedicated bailers. The collection procedure is described below.
  - (1) Bailer - After purging the well and sufficient recharge has been allowed, samples for volatile organics should be collected using the first bailer volume. Lower the bailer slowly until it contacts the water surface, and allow the bailer to sink to the desired depth and fill, with a minimum of surface disturbance. Slowly withdraw the bailer, taking care to prevent contact of the bailer line with the ground. Slowly discharge the contents into the appropriate sample containers. Repeat the process as necessary to fill each container to the required volume. Vials for volatile analysis will be completely filled, leaving no air space above the liquid portion (to minimize volatilization). Check that the Teflon on the Teflon-lined silicone septum is toward the sample in the caps and secure the cap tightly. If semi-volatile compounds are to be sampled for, collect these samples next. Proceed to the collection of samples for the remaining analyses. Be careful of all pre-preserved bottles. If acids are present, open the bottle upwind and away from the body. Table 2-15 lists the parameters analyzed at each site and the methods employed.
  - (2) Bladder Pump - After purging, the air hose will be fitted to the air line nipple on the bladder pump



TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
<b>BACKGROUND:</b>	
<b>GROUND WATER AND SURFACE WATER</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3520/8270
Metals (totals only)	
ICP	SW 3005/6010
GFAA	
Arsenic	SW 7060
Selenium	SW 7740
Lead	SW 3020/7421 **
Thallium	SW 3020/7841
CVAA	
Mercury	SW 7470
Cyanide	SW 9010
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Pesticides	SW 3520/8080
Explosives (ground water only)	SW 8330
Total Dissolved Solids	EPA 160.1
<b>SOIL AND SEDIMENT</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3550/8270
Metals	
ICP	SW 3050/6010
GFAA	
Arsenic	SW 3050/7060
Selenium	SW 3050/7740
Lead	SW 3050/7421 **
Thallium	SW 3050/7841
CVAA	
Mercury	SW 7471
Cyanide	SW 9012
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Pesticides/PCBs	SW 3550/8080

TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
<b>SITE 1 - LANDFILL:</b>	
<b>GROUND WATER AND SURFACE WATER</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3520/8270
Metals (totals only)	
ICP	SW 3005/6010
GFAA	
Arsenic	SW 7060
Selenium	SW 7740
Lead	SW 3020/7421 **
Thallium	SW 3020/7841
CVAA	
Mercury	SW 7470
Cyanide	SW 9010
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Pesticides	SW 3520/8080
Explosives (ground water only)	SW 8330
Total Dissolved Solids	EPA 160.1
<b>SOIL AND SEDIMENT</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3550/8270
Metals	
ICP	SW 3050/6010
GFAA	
Arsenic	SW 3050/7060
Selenium	SW 3050/7740
Lead	SW 3050/7421 **
Thallium	SW 3050/7841
CVAA	
Mercury	SW 7471
Cyanide	SW 9012
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Pesticides/PCBs	SW 3550/8080

TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
<b>SITE 2 – FIRE PROTECTION AREA NO. 1:</b>	
<b>GROUND WATER AND SURFACE WATER</b>	
No water samples collected	
<b>SOIL AND SEDIMENT</b>	
Volatile Organic Compounds	SW 8240
Total Petroleum Hydrocarbons	LUFT Cal-DHS
<b>SITE 3 – FIRE PROTECTION AREA NO. 2:</b>	
<b>GROUND WATER</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3520/8270
Metals (totals only)	
ICP	SW 3005/6010
GFAA	
Arsenic	SW 7060
Selenium	SW 7740
Lead	SW 3020/7421 **
Thallium	SW 3020/7841
CVAA	
Mercury	SW 7470
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Pesticides	SW 3520/8080
Total Dissolved Solids	EPA 160.1
<b>SOIL</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3550/8270
Metals	
ICP	SW 3050/6010
GFAA	
Arsenic	SW 3050/7060
Selenium	SW 3050/7740
Lead	SW 3050/7421 **
Thallium	SW 3050/7841
CVAA	
Mercury	SW 7471
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Pesticides/PCBs	SW 3550/8080

TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
<b>SITE 4 – FIRE PROTECTION AREA NO. 3:</b>	
<b>GROUND WATER</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3520/8270
Metals (totals only)	
ICP	SW 3005/6010
GFAA	
Arsenic	SW 7060
Selenium	SW 7740
Lead	SW 3020/7421 **
Thallium	SW 3020/7841
CVAA	
Mercury	SW 7470
Total Petroleum Hydrocarbons	LUFT Cal-DHS
Total Dissolved Solids	EPA 160.1
<b>SOIL</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3550/8270
Metals	
ICP	SW 3050/6010
GFAA	
Arsenic	SW 3050/7060
Selenium	SW 3050/7740
Lead	SW 3050/7421 **
Thallium	SW 3050/7841
CVAA	
Mercury	SW 7471
Total Petroleum Hydrocarbons	LUFT Cal-DHS

TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
<b>SITE 5 - FACILITY 8550:</b>	
<b>GROUND WATER AND SURFACE WATER</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3520/8270
Metals (totals only)	
ICP	SW 3005/6010
GFAA	
Arsenic	SW 7060
Selenium	SW 7740
Lead	SW 3020/7421 **
Thallium	SW 3020/7841
CVAA	
Mercury	SW 7470
Total Petroleum Hydrocarbons (ground water only)	LUFT Cal-DHS
(Semi-VOA extraction only)	
Total Dissolved Solids	EPA 160.1
<b>SOIL AND SEDIMENT</b>	
Volatile Organic Compounds (soil only)	SW 8240
Semi-volatile Organic Compounds	SW 3550/8270
Metals	
ICP	SW 3050/6010
GFAA	
Arsenic	SW 3050/7060
Selenium	SW 3050/7740
Lead	SW 3050/7421 **
Thallium	SW 3050/7841
CVAA	
Mercury	SW 7471
Total Petroleum Hydrocarbons (soil only)	LUFT Cal-DHS
(Semi-VOA extraction only)	

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

6 of 8

TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
<b>SITE 7 – GROUND WATER AND SLUDGE WEATHERING LAGOON:</b>	
<b>SURFACE WATER</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3520/8270
Metals (totals only)	
ICP	SW 3005/6010
GFAA	
Arsenic	SW 7060
Selenium	SW 7740
Lead	SW 3020/7421**
Thallium	SW 3020/7841
CVAA	
Mercury	SW 7470
Total Petroleum Hydrocarbons	LUFT Cal–DHS
Total Dissolved Solids	EPA 160.1
<b>SEDIMENT</b>	
Volatile Organic Compounds	SW 8240
Semi-volatile Organic Compounds	SW 3550/8270
Metals	
ICP	SW 3050/6010
GFAA	
Arsenic	SW 3050/7060
Selenium	SW 3050/7740
Lead	SW 3050/7421**
Thallium	SW 3050/7841
CVAA	
Mercury	SW 7471
Total Petroleum Hydrocarbons	LUFT Cal–DHS

TABLE 2-15

**ANALYTICAL METHODS**  
**Scott Air Force Base, Illinois**

PARAMETER	METHOD
SITE 8 - BUILDING 1680: No further sampling required	

SW - Test Methods for Evaluating Solid Waste. EPA SE-846, 3rd Edition, 1986.

EPA - Method for Chemical Analysis of Water and Sastes. EPA 600/4-79-020, March 1983.

LUFT Cal-DHS - Department of Health Services. 1985. Recommended Methods of Analysis for the Organic Components Required for AB 1803, Fourth Edition. California DHS Sanitation and Radiation laboratory, Berkeley, CA.

\* - Ground-water samples will only be analyzed for volatile organic compounds.

\*\* - If the lead concentration detected on the ICP is > 10x the instrument detection limit (IDL) on the ICP, the ICP value can be used, even if the IDL is above the AFCEE Maximum Quantitation Limit found in Table 2-2 of the AFCEE Handbook to Support the Installation Restoration Program (IRP) Statements of Work (Version 4.0). If the lead concentration detected on the ICP is < 10x the IDL on the ICP, then the GFAA analysis is required.



and the compressor will be turned on. The discharge rate for the bladder pump should be set around 100 mls/minute for successful volatile sampling. This rate will be measured by using a 100 ml graduated cylinder and timing the flow. The flow rate will be adjusted with the controller until 100 mls/minute is achieved. Volatile samples will be collected first. Vials for volatile analysis will be completely filled leaving no air space. Semi-volatile samples will be filled next. Proceed with the collection of samples for the remaining analyses.

- f. Measure Water Level - After samples have been collected, the well cap should be replaced. Static water level will be measured again after sufficient recharge has been allowed (24 hours).
- g. Measure pH, Temperature and Specific Conductance - Follow procedure as outlined in Section 2.3.
- h. Custody, Handling and Shipping - Complete the procedures as outlined in Sections 2.2.2 and 2.2.3.

2.2.1.2 Soil Sampling - Samples will be collected from soil borings of the newly-installed monitoring wells, from independent soil borings, and from surface soils. Table 2-16 lists the samples taken from each site. TCLP analysis may not be performed on drummed soil cuttings; data from the total analyses will be reviewed and if analytes are present at concentrations that may exceed a TCLP regulatory limit, then TCLP will be performed.

The following section discusses soil sampling and collection procedures. Included are discussions of soil sampling protocol and equipment.

**TABLE 2-16**  
**SOIL AND SEDIMENT SAMPLES**  
**Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>BACKGROUND:</b>	MWB-1S	2
	MWB-1DS	3
	MWB-2S	2
	MWB-2DS	3
	SDB-1	3
	SDB-2	1
	SDB-3	1
	SSB-1	1
	SSB-2	1
	SSB-3	1
	SSB-4	1
	SSB-5	1
	SSB-6	1
	SSB-7	1
	SSB-8	1
	SSB-9	1
	SSB-10	1
<b>LANDFILL:</b>	MW1-12S	0
	MW1-12DS	3
	MW1-13S	0
	MW1-13DS	3
	MW1-14S	0
	MW1-14DS	3
	MW1-15S	0
	MW1-15RS	3
	MW1-16S	0
	MW1-16DS	3
	MW1-17S	2
	MW1-18S	2
	MW1-19S	2
	MW1-20S	2
	MW1-21S	2
	MW1-22S	2
	MW1-23S	2
	SS1-9	1

**TABLE 2-16**

**SOIL AND SEDIMENT SAMPLES  
Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>LANDFILL (continued):</b>	SS1-10	1
	SS1-11	1
	SS1-12	1
	SS1-13	1
	SS1-14	1
	SS1-15	1
	SS1-16	1
	SS1-17	1
	SS1-18	1
	SS1-19	1
	SS1-20	1
	SS1-21	1
	SS1-22	1
	SS1-23	1
	SS1-24	1
	SS1-25	1
	SS1-26	1
	SS1-27	1
	SS1-28	1
	SD1-7	1
	SD1-8	1
	SD1-9	1
	SD1-10	1
	SD1-11	1
<b>FPTA No. 1:</b>	SS2-1	1
	SS2-2	1
	SS2-3	1
	SS2-4	1
	SS2-5	1

TABLE 2-16

**SOIL AND SEDIMENT SAMPLES**  
**Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>FPTA No. 2:</b>	SB3-3	2
	SB3-4	2
	MW3-4S	2
	MW3-5S	2
	SS3-1	1
	SS3-2	1
	SS3-3	1
	SS3-4	1
	SS3-5	1
<b>FPTA No. 3:</b>	MW4-4S	0
	MW4-4DS	3
	MW4-5S	2
	MW4-6S	2
	SB4-4	2
	SB4-5	2
	SB4-6	2
	SB4-7	2
<b>FACILITY 8550:</b>	MW5-4S	2
	MW5-5S	2
	MW5-6S	2
	SS5-1	1
	SS5-2	1
	SS5-3	1
	SS5-4	1
	SS5-5	1
	SS5-6	1
	SS5-7	1
	SS5-8	1
	SS5-9	1
	SS5-10	1
	SD5-1	1
	SD5-2	1
	SD5-3	1
	SD5-4	1
	SD5-5	1

**TABLE 2-16**

**SOIL AND SEDIMENT SAMPLES  
Scott Air Force Base, Illinois**

SITE	SAMPLE ID	NUMBER OF SAMPLES TAKEN
<b>FACILITY 1965:</b>	HSB6-1	2
	HSB6-2	2
	HSB6-3	2
	HSB6-4	2
	HSB6-5	2
	HSB6-6	2
	HSB6-7	2
	HSB6-8	2
	HSB6-9	2
	HSB6-10	2
	HSB6-11	2
	HSB6-12	2
	HSB6-13	2
	HSB6-14	2
	HSB6-15	2
	HSB6-16	2
	HSB6-17	2
	HSB6-18	2
	HSB6-19	2
	HSB6-20	2
	MW6-4S	2
	MW6-5S	2
	MW6-6S	2
	MW6-7S	2
	MW6-8RS	2
<b>SLUDGE WEATHERING LAGOON:</b>	SD7-1	1
	SD7-2	1
	SD7-3	1
	SD7-4	1
<b>BUILDING 1680:</b>	No further sampling required.	

SB = Soil Boring  
SS = Surface Soil  
SD = Sediment  
HSB = Soil Boring from Hydropunch

Subsurface soil samples for laboratory analysis will be collected using a stainless-steel split spoon sampler with California brass ring inserts, and surface soil samples will be collected using a hand auger. Care has been taken to determine the best practical sampling procedure that will result in obtaining representative samples. The samples must maintain the integrity of the original medium through collection, transportation, and delivery to the analyst. The soil samples will be collected and containerized as described in the following paragraphs.

Subsurface soil samples - Two sizes of hollow stem augers will be used at the sites. A 6 $\frac{1}{4}$ -inch auger will be used to drill the bore hole for the 2-inch diameter monitoring wells and the independent soil borings. A 8 $\frac{1}{4}$ -inch auger will be used to drill the bore hole for the 6-inch diameter recovery wells. The auger will encase an 18-inch long, stainless-steel split spoon which will, in turn, encase three 6-inch California brass rings. Each boring will be advanced using a hollow-stem auger. Section 2.1 describes the depths at which the samples will be collected. The split spoon will be placed on a sheet of aluminum foil upon retrieval from the auger. Each end of the split spoon will be opened by unscrewing the end caps. Samples from certain borings are to be collected at depths which exhibit the highest organic vapor readings. A hand held organic vapor analyzer (HNU) will be used to screen the individual boring samples. The split spoon will be opened and the end of each brass ring screened. The sample(s) exhibiting the highest organic vapor readings will be sent to the laboratory for analysis. After the boring samples have been screened for organic vapor, the brass rings will be sealed with a teflon patch and plastic cap, thus encasing the sample in the brass ring. The middle 6-inch brass ring sample will be sent to the laboratory for volatile organic compound analysis. Soil from the remaining two brass rings will be removed and placed into a stainless-steel mixing bowl. The sample will be thoroughly mixed with a stainless-steel spoon and placed into the appropriate pre-cleaned jars (Table 5-1 from the QAPP).

Surface soil samples - Surface soil samples will be collected at a depth of 0-2 feet. Surface soil samples will be collected using a stainless-steel hand auger.

The sampling protocol at Scott AFB will be as follows:

- a. Position the hand auger bucket over the desired sampling location.
- b. Drive the auger bucket directly into the soil. Rotate the auger as necessary to reach a sampling depth of 2 feet, avoiding excess disturbance of surface particles.
- c. Retrieve the auger by lifting upward.
- d. Place auger into a stainless-steel mixing bowl and empty contents of the bucket into the bowl.
- e. Immediately sample for volatiles by filling vials completely full, avoiding headspace.
- f. Once the volatile organic samples have been collected, mix the remaining soil thoroughly.
- g. Place the well-mixed soil into the appropriate pre-labeled sample containers (Table 5-1 from QAPP).

Table 2-3 lists the parameters analyzed at each site and the analytical methods employed.

- Label Sample - Label the surface and subsurface sample bottles as outlined in Section 2.2.2.
- Chain-of Custody and Shipping - Complete the procedures as outlined in Sections 2.2.2 and 2.2.3 for the chain-of-custody sample handling and shipping.

2.2.1.3 Surface Water Sampling - Surface water samples will be collected from Silver Creek and Mosquito Creek. Table 2-14 lists the samples taken from each site. The equipment and protocol for collecting surface water samples at Scott AFB is discussed in the following paragraph.

Surface water samples will be collected with stainless-steel beakers in "high-flow" areas. Each beaker will be cleaned using the method described in Section 4.4 before sample collection. Collect samples from the downstream to the upstream locations. Slowly submerge the beaker into the water. When the beaker is full, slowly pour the contents down the side and into the sample bottles. Completely fill volatile vials first, leaving no headspace. Fill sample containers for the remaining analyses.

2.2.1.4 Sediment Sampling - Sediment samples will be collected from Silver Creek and Mosquito Creek. Table 2-16 lists the samples taken from each site. The equipment and protocol for collecting sediment samples at Scott AFB is discussed in the following paragraph.

Sediment samples will be collected with stainless-steel hand augers. Collect the sample by driving the hand auger through the water and into the sediments. Rotate the auger as necessary to reach a sample depth of 6 inches, avoiding excess disturbance of surface sediment particles. Retrieve the auger by lifting upward and empty the contents of the auger bucket into a stainless-steel mixing bowl. Completely fill volatiles first, leaving no headspace. Once the volatile organic samples have been collected, mix the remaining sediment thoroughly and fill sample containers for the remaining analyses.



### 2.2.2 Sample Handling

The following sections describe the proper way to label, identify, ship, and preserve samples.

2.2.2.1 Sample Labels - Field sampling personnel must properly identify all samples taken in the field with an adhesive sample label attached to the sample container. The sample label must contain the site name, field identification number; the date, time, and location of sample collection; designation of the sample as a grab or composite; notation of the type of sample (e.g., ground-water, soil boring, etc.); identification of preservatives used; any remarks; and the signature of the sampler. The sample labels will be placed on the bottles so as not to obscure any QA/QC data, and sample information will be legibly printed with waterproof ink. Field identification must be sufficient to allow easy cross-reference with the site logbook. Clear tape will be placed over the label to prevent removal or damage.

2.2.2.2 Sample Identification - The following section describes how each sample will be identified and what this identification signifies.

The sample identification (ID) prefix is as follows:

- MW - New or existing monitoring wells installed
- SW - Surface water
- SB - Soil borings in which no monitoring well was installed
- SD - Sediment
- HP - Water collected by hydropunch
- HSB- Soil samples collected from hydropunch borings
- TB - Trip Blank
- AB - Ambient Condition Blank

DC - Drill Cuttings  
RN - Rinsate (Equipment blank)  
SS - Independent Surface Soils

MS/MSD

The number or character immediately following the sample prefix indicates which site the sample comes from. These numbers and their associated sites are as follows:

- B - Background
- 1 - Landfill
- 2 - Fire Protection Training Area No. 1
- 3 - Fire Protection Training Area No. 2
- 4 - Fire Protection Training Area No. 3
- 5 - Facility 8850 Spill Site
- 6 - Facility 1965 Spill Site
- 7 - Sludge Weathering Lagoon
- 8 - Building 1680 (Old Dental Clinic)

The following number(s) represent the number of the ground-water, soil, surface water or sediment sample. Soil samples collected from monitoring wells will have two additional character fields following the sample number. The first character will be to indicate the soil matrix while the second character field indicates the depth from which the sample was taken. The depth characters are defined as follows:

- A - the shallowest soil boring sample taken
- B - the second shallowest soil boring sample taken (or the deepest if only two samples are taken)
- C - the third shallowest soil boring sample taken (or the deepest if three samples are taken)

Some ground-water samples collected from existing monitoring wells have either the suffix "S" or "D" attached to the number of the sample. These characters signify shallow and deep wells

respectively. Newly installed deep wells (for both ground-water "MW" and soil "SB" samples) will have the "D" suffix attached to their respective number, and wells without a suffix are assumed to be shallow.

Trip blanks will be labeled TB-XX. The "XX" are consecutive numbers from 1-9.

Ambient condition blanks will be labeled with the appropriate prefix and numbered from 1-9.

Drill cuttings will be labeled DC-XX. The "XX" are consecutive numbers from 1 up to the number of drums to be analyzed.

Rinsate or equipment blanks will be labeled RN-XX. The "XX" indicates the sample number that the rinsate was collected. For example, if the rinsate was collected on the surface soil SS2-01 then the rinsate would be labeled RN-SS2-01.

Duplicates/replicates will be labeled in a manner so as to hide the identity of the sample as a duplicate/replicate. This will be accomplished by adding the number "1" to the sample ID, such as SS2-1XXX. Sample SS2-1101 is a duplicate of SS2-101.

Matrix spike/matrix spike duplicate samples will have the same sample identification number with either the MS or MSD suffix attached.

2.2.2.3 Handling and Shipping - The properly labeled and sealed sample containers will be placed in plastic "Ziploc" type bags and sealed. Approximately three inches of inert cushioning and absorbing material, such as vermiculite, will be placed in the bottom of the cooler. Bagged sample containers will be placed in the bottom of the cooler. Bagged sample containers will be

arranged in the cooler so that they do not touch, and will be packed in double ziploc bagged ice and additional packing material to prevent breakage. Samples should be packed so as to maintain a temperature of 4°C during shipment. Chain-of-custody documents will be sealed in air-tight plastic bags and taped to the inside of the cooler lid.

The lid of the container will be taped shut and sealed with custody seals. Samples will be shipped directly to the laboratory by overnight courier on the day they are collected. The laboratory will be notified by phone of the sample shipment schedule and arrival time. No samples will be held more than 24 hours on-site.

2.2.2.4 Sample Preservation - Samples requiring preservation will be sampled into pre-preserved bottles. The sample containers, sample volumes, holding times and preservation are presented in Table 5-1 of the QAPP.

#### 2.2.3 Sample Custody

Field sample custody procedures are outlined below.

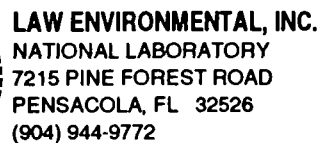
2.2.3.1 Chain-of-Custody Record - Chain-of-Custody records will be provided in each sample cooler. The custody record will be fully completed, in triplicate, by the field technician designated by the Project Manager as responsible for sample shipment to the laboratory. The information specified on the chain-of-custody record will contain the same level of detail found in the site logbook, with the exception that on-site measurement data will not be recorded. The custody record will include, among other things, the following information: name of person collecting the samples, date samples were collected, type of sampling conducted (composite/grab), location of sampling station (including the site

location), number and type of containers used, and signature of the Law person relinquishing samples to a non-Law person (such as a Federal Express agent), with the date and time of transfer noted.

In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns such as extraction time or sample retention period limitations, the person completing the chain-of-custody record should note these constraints in the remarks section of the custody record. Figure 2-13 shows the LENL Chain-of-Custody record. The same Chain-of-Custody form will be adapted for all subcontract laboratories unless a form is provided by the subcontract laboratory. If it is not practicable to seal all containers at a Federal Express office, they will be sealed beforehand. The duplicate custody record will, therefore, have the signature of the relinquishing field technician and a statement of intent (for example, "To Federal Express (Baltimore office) p.m. 6/31/90).

The duplicate custody record will then be placed in a plastic bag, taped to the underside of the cooler lid, and the cooler closed. The container will be tightly bound with filament tape, and if required by the Project Manager, may be padlocked. Finally, seals will be signed by the individual relinquishing custody and affixed in such a way that the box cannot be opened without breaking the seals.

At the shipping agent's office, the relinquishing individual will write all the specific shipping data (airway bill number, office, time, and data) on the original custody record. The original and duplicate custody records and the airway bill or delivery note together constitute a complete record, and it is the responsibility of the Project Manager to ensure that all records are consistent and that they are made part of the permanent job file maintained at LENL.



## CHAIN OF CUSTODY RECORD

4636

**SAMPLING INFORMATION**

**NAME OF FACILITY:** \_\_\_\_\_

**STREET ADDRESS:** \_\_\_\_\_

**CITY/STATE:** \_\_\_\_\_ **ZIP:** \_\_\_\_\_

[illegible]

**DISTRIBUTION:** ORIGINAL AND PINK COPIES ACCOMPANY SAMPLE SHIPMENT TO LABORATORY. PINK COPY RETAINED BY LABORATORY. YELLOW COPY RETAINED BY SAMPLERS.

REMARKS: \_\_\_\_\_

\* SOURCE RECOVERY WELL - RW  
CODES: RCRA MONITORING WELL - MW  
SOIL/SEDIMENT - SO  
SLUDGE - SL  
NPDES DISCHARGE - ND  
DRINKING WATER - DW

HF



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At the laboratory, the Sample Control Coordinator will open the package, retrieve the duplicate record, and complete the "Received for Laboratory by" box by affixing his/her signature.

The figure coordinator will also fill in the "Method of Shipment" box with the shipper's name (e.g., Federal Express) and airway bill number.

2.2.3.2 Custody Seals - Custody seals will be pre-printed, adhesive-backed seals with security slots designed to break if disturbed. Sample shipping containers (coolers, cardboard boxes, etc., as appropriate) will be sealed in as many places as necessary to ensure security. Seals will be signed and dated before use. Upon receipt by the laboratory, the custodian will check and certify, by completing logbook entries, that the seals on boxes and bottles are intact.

#### 2.2.4 QC Samples

Quality control (QC) samples are collected and analyzed for the purpose of assessing the quality of the sampling effort and the analytical data. QC samples include duplicates and replicates of field samples, rinsate blanks, trip blanks, ambient condition blanks and background (upgradient) samples. The type, description, preparation and collection, and frequency of field QC samples are discussed in the following section.

• Field Sample - This is the total sample collected at a specific site location. This sample may be any matrix and may be divided to provide material for analysis for QC samples.

- QC Samples - Samples analyzed by LENL to help the Law project team and LENL to identify and diagnose problems related to sampling analysis. QC samples represent approximately 10 percent of the field samples.
- Replicate - A single sample divided into two equal parts for analysis. Field replicates represent 10% of all soil and sediment samples collected.
- Duplicate - Two samples collected independently at a sampling location during a single act of sampling. Field duplicates represent 10 percent of all water samples collected.
- Rinsate Blank - Samples consisting of reagent water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of rinsate blanks is to determine whether the sampling equipment is causing cross contamination of samples.
- Trip Blank - Containers of the organic-free reagent water that are kept with the field sample containers from the time they leave the laboratory until the time they are returned to the laboratory. The purpose of the trip blank is to determine whether samples are being contaminated during transit or sample collection. Trip blanks pertain only to volatile organic analyses; therefore, the containers must contain no headspace. Only one trip blank is required per sampling day and shall satisfy trip blank requirements for all water matrices for that day if the volatile samples are shipped in the same cooler. However, if more than one cooler contains volatile samples, then a trip blank will be placed in each cooler containing volatile samples.
- Ambient Condition Blank - Samples consisting of organic-free reagent water prepared and opened at the site. Ambient condition blanks are used to measure the influence of ambient



volatile conditions at a particular sampling location. Ambient condition blanks will not necessarily be collected every time volatile samples are collected. They will be collected when samples are collected downwind of possible volatile sources such as active runways or an adjacent highway.

Background (upgradient) Sample - Sample representing the least potential for contamination at a given sight. At least one background sample of each matrix should be collected. The background ground-water samples will be collected from the upgradient well clusters MWB-1, MWB-1D, MWB-2 and MWB-2D. These wells represent all aquifers. Background soil samples will be obtained from the monitoring well location located east of the background well cluster. Ten background surface soil samples will be collected in the general vicinity of the background well cluster. Three surface water and sediment samples will be collected as background samples upstream in Silver Creek.

#### 2.2.5 Sample Analysis Summary

Tables 2-17 and 2-18 a, b, c present a summary of the environmental samples and the proposed QC samples and parameters to be analyzed for each site.

### 2.3 FIELD MEASUREMENTS

#### 2.3.1 Parameters For Field Characterization Of Samples

Certain chemical constituents in ground water can fluctuate considerably with time. These constituents are pH, temperature and specific conductivity. These parameters will be measured in the field when the samples are obtained and recorded on the Field

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)			[Analytical Parameter]		
					California brass ring or 2oz VOA (Cool to 4°C)	8 oz glass soil jar (Cool to 4°C)	8 oz glass soil jar (Cool to 4°C)	8 oz glass soil jar (Cool to 4°C)	8 oz glass soil jar (Cool to 4°C)	8 oz glass soil jar (Cool to 4°C)
					[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]
			DATE	TIME	brass ring	2 oz VOA		VOA	S-VOA	
<b>FIELD SAMPLES – SITE</b>										
<b>BACKGROUND:</b>										
1	MWB-1SA				1		1	X	1	1
2	MWB-1SB				1		1	X	1	1
3	MWB-1DSA				1		1	X	1	1
4	MWB-1DSB				1		1	X	1	1
5	MWB-1DSC				1		1	X	1	1
6	MWB-2SA				1		1	X	1	1
7	MWB-2SB				1		1	X	1	1
8	MWB-2DSA				1		1	X	1	1
9	MWB-2DSB				1		1	X	1	1
10	MWB-2DSC				1		1	X	1	1
11	MWB-12DSC	Duplicate of MWB-2DSC #			1		1	X	1	1
12	SDB-1					1	1	X	1	1
13	SDB-2					1	1	X	1	1
14	SDB-3					1	1	X	1	1
15	SSB-1					1	1	X	1	1
16	SSB-2					1	1	X	1	1
17	SSB-3					1	1	X	1	1
18	SSB-4					1	1	X	1	1
19	SSB-5					1	1	X	1	1
20	SSB-15	Duplicate of SSB-5 #				1	1	X	1	1
21	SSB-6					1	1	X	1	1
22	SSB-7					1	1	X	1	1
23	SSB-8					1	1	X	1	1
24	SSB-9					1	1	X	1	1
25	SSB-10					1	1	X	1	1
<b>LANDFILL:</b>										
26	MW1-12DSA				1		1	X	1	1
27	MW1-12DSB				1		1	X	1	1
28	MW1-12DSC				1		1	X	1	1
29	MW1-13DSA	Request MS/MSD here			3		3	X	3	3
30	MW1-13DSB				1		1	X	1	1
31	MW1-13DSC				1		1	X	1	1
32	MW1-113DSC	Duplicate of MW1-13DSC #			1		1	X	1	1
33	MW1-14DSA				1		1	X	1	1
34	MW1-14DSB				1		1	X	1	1
35	MW1-14DSC				1		1	X	1	1
36	MW1-15RSA				1		1	X	1	1
37	MW1-15RSB				1		1	X	1	1
38	MW1-115RSB	Duplicate of MW1-15SB #			1		1	X	1	1
39	MW1-15RSC				1		1	X	1	1
*# = hide identity from laboratory					*X = Sample obtained from the brass ring of the VOA sample.					

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)			[Analytical Parameter]		
					California brass ring	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar
					(Cool to 4°C) [VOAs]	(Cool to 4°C) [SVOAs]	(Cool to 4°C) [Pest/PCBs]	(Cool to 4°C) [TPH]	(Cool to 4°C) [Metals, total]	(Cool to 4°C) [Cyanide]
			DATE	TIME	brass ring 2 oz VOA			VOA S-VOA		
<b>FIELD SAMPLES – SITE</b>										
<b>LANDFILL:</b>										
40	MW1-16DSA				1	1	1	X 1	1	1
41	MW1-16DSB				1	1	1	X 1	1	1
42	MW1-16DSC				1	1	1	X 1	1	1
43	MW1-17SA				1	1	1	X 1	1	1
44	MW1-17SB				1	1	1	X 1	1	1
45	MW1-117SB	Duplicate of MW1-17SB #			1	1	1	X 1	1	1
46	MW1-18SA	Request MS/MSD here			3	3	3	X 3	3	3
47	MW1-18SB				1	1	1	X 1	1	1
48	MW1-19SA				1	1	1	X 1	1	1
49	MW1-19SB				1	1	1	X 1	1	1
50	MW1-20SA				1	1	1	X 1	1	1
51	MW1-20SB				1	1	1	X 1	1	1
52	MW1-21SA				1	1	1	X 1	1	1
53	MW1-21SB				1	1	1	X 1	1	1
54	MW1-22SA				1	1	1	X 1	1	1
55	MW1-22SB				1	1	1	X 1	1	1
56	MW1-122SB	Duplicate of MW1-22SB #			1	1	1	X 1	1	1
57	MW1-23SA				1	1	1	X 1	1	1
58	MW1-23SB				1	1	1	X 1	1	1
59	SS1-9					1	1	X 1	1	1
60	SS1-10					1	1	X 1	1	1
61	SS1-11					1	1	X 1	1	1
62	SS1-12					1	1	X 1	1	1
63	SS1-112	Duplicate of SS1-12 #				1	1	X 1	1	1
64	SS1-13					1	1	X 1	1	1
65	SS1-14					1	1	X 1	1	1
66	SS1-15					1	1	X 1	1	1
67	SS1-16					1	1	X 1	1	1
68	SS1-17					1	1	X 1	1	1
69	SS1-18					1	1	X 1	1	1
70	SS1-19					1	1	X 1	1	1
71	SS1-20	Request MS/MSD here			3	3	3	X 3	3	3
72	SS1-21					1	1	X 1	1	1
73	SS1-22					1	1	X 1	1	1
74	SS1-23					1	1	X 1	1	1
75	SS1-24					1	1	X 1	1	1
76	SS1-25					1	1	X 1	1	1
77	SS1-26					1	1	X 1	1	1

\*#\* = hide identity from laboratory

\*X\* = Sample obtained from the brass ring of the VOA sample.

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)				[Analytical Parameter]		
					California brass ring	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar
					(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)
					[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]	
			DATE	TIME	brass ring	2 oz VOA		VOA	S-VOA		
<b>FIELD SAMPLES – SITE</b>											
<b>LANDFILL:</b>											
78	SS1-27					1	1		X	1	1
79	SS1-127	Duplicate of SS1-27 #				1	1		X	1	1
80	SS1-28					1	1		X	1	1
81	SD1-7					1	1		X	1	1
82	SD1-8					1	1		X	1	1
83	SD1-9					1	1		X	1	1
84	SD1-10	Request MS/MSD here				3	3		X	3	3
85	SD1-11					1	1		X	1	1
86	SD1-111	Duplicate of SD1-11 #				1	1		X	1	1
<b>FPTA No. 1</b>											
87	SS2-1					1	0		X	1	0
88	SS2-2					1	0		X	1	0
89	SS2-3					1	0		X	1	0
90	SS2-4					1	0		X	1	0
91	SS2-5										
<b>FPTA No. 2:</b>											
92	SB3-3A					1	1		X	1	0
93	SB3-3B					1	1		X	1	0
94	SB3-4A					1	1		X	1	0
95	SB3-4B					1	1		X	1	0
96	MW3-4SA					1	1		X	1	0
97	MW3-4SB					1	1		X	1	0
98	MW3-5SA					1	1		X	1	0
99	MW3-5SB					1	1		X	1	0
100	SS3-1						1		X	1	0
101	SS3-11	Duplicate of SS3-1 #				1	1		X	1	0
102	SS3-2					1	1		X	1	0
103	SS3-3					1	1		X	1	0
104	SS3-4					1	1		X	1	0
105	SS3-5					1	1		X	1	0
<b>FPTA No. 3:</b>											
106	MW4-4DSA					1	1		X	1	0
107	MW4-4DSB					1	1		X	1	0
108	MW4-4DSC					1	1		X	1	0
109	MW4-5SA					1	1		X	1	0
110	MW4-15SA	Duplicate of MW4-5SA #				1	1		X	1	0

"#" = hide identity from laboratory

"X" = Sample obtained from the brass ring of the VOA sample

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION DATE      TIME		Number and Type of Sample Containers (Preservative)						[Analytical Parameter]	
					California brass	8 oz glass	8 oz glass	8 oz glass	8 oz glass	8 oz glass		
					ring	soil jar	soil jar	soil jar	soil jar	soil jar		
					(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)		
[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]							
brass ring	2 oz VOA			VOA	S-VOA							
FIELD SAMPLES – SITE												
FPTA No. 3:												
111	MW4-5SB	Request MS/MSD here			3	3	0	X	3	3		0
112	MW4-6SA				1	1	0	X	1	1		0
113	MW4-6SB				1	1	0	X	1	1		0
114	SB4-4A				1	1	0	X	1	1		0
115	SB4-4B				1	1	0	X	1	1		0
116	SB4-5A				1	1	0	X	1	1		0
117	SB4-5B				1	1	0	X	1	1		0
118	SB4-6A				1	1	0	X	1	1		0
119	SB4-6B				1	1	0	X	1	1		0
120	SB4-7A				1	1	0	X	1	1		0
121	SB4-7B	Request MS/MSD here			3	3	0	X	3	3		0
FACILITY 8550:												
122	MW5-4SA				1	1	0	0	1	1		0
123	MW5-4SB				1	1	0	0	1	1		0
124	MW5-5SA				1	1	0	0	1	1		0
125	MW5-5SB				1	1	0	0	1	1		0
126	MW5-15SB	Duplicate of MW5-5SB #			1	1	0	0	1	1		0
127	MW5-6SA				1	1	0	0	1	1		0
128	MW5-6SB				1	1	0	0	1	1		0
129	SS5-1					1	0	0	1	1		0
130	SS5-2					1	0	0	1	1		0
131	SS5-3					1	0	0	1	1		0
132	SS5-4					1	0	0	1	1		0
133	SS5-5					1	0	0	1	1		0
134	SS5-6					1	0	0	1	1		0
135	SS5-8					1	0	0	1	1		0
136	SS5-9					1	0	0	1	1		0
137	SS5-19	Duplicate of SS5-9 #				1	0	0	1	1		0
138	SS5-10	Request MS/MSD here				3	0	0	3	3		0
139	SD5-1					1	0	0	1	1		0
140	SD5-2					1	0	0	1	1		0
141	SD5-3					1	0	0	1	1		0
142	SD5-4					1	0	0	1	1		0
143	SD5-5					1	0	0	1	1		0
FACILITY 1985:												
144	HSB6-1A				1 *	0	0	0	0	0		0

\*# = hide identity from laboratory

\*\*\* = Bottles will be provided by TARGET. "X" = Sample obtained from the brass ring of the VOA sample.

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)						[Analytical Parameter]	
					California brass ring	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar
					(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)
					[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]		
			DATE	TIME	brass ring 2 oz VOA			VOA S-VOA				
<b>FIELD SAMPLES – SITE</b>												
<b>FACILITY 1985:</b>												
145	HSB6-1B				1 *	0	0	0	0	0	0	0
146	HSB6-2A				1 *	0	0	0	0	0	0	0
147	HSB6-2B				1 *	0	0	0	0	0	0	0
148	HSB6-22B	Duplicate of HSB6-2B #			1 *	0	0	0	0	0	0	0
149	HSB6-3A				1 *	0	0	0	0	0	0	0
150	HSB6-3B				1 *	0	0	0	0	0	0	0
151	HSB6-4A				1 *	0	0	0	0	0	0	0
152	HSB6-4B				1 *	0	0	0	0	0	0	0
153	HSB6-5A				1 *	0	0	0	0	0	0	0
154	HSB6-5B				1 *	0	0	0	0	0	0	0
155	HSB6-6A				1 *	0	0	0	0	0	0	0
156	HSB6-6B				1 *	0	0	0	0	0	0	0
157	HSB6-7A				1 *	0	0	0	0	0	0	0
158	HSB6-7B				1 *	0	0	0	0	0	0	0
159	HSB6-27B	Duplicate of HSB6-7B #			1 *	0	0	0	0	0	0	0
160	HSB6-8A	Request MS/MSD here			3 *	0	0	0	0	0	0	0
161	HSB6-8B				1 *	0	0	0	0	0	0	0
162	HSB6-9A				1 *	0	0	0	0	0	0	0
163	HSB6-9B				1 *	0	0	0	0	0	0	0
164	HSB6-10A				1 *	0	0	0	0	0	0	0
165	HSB6-10B				1 *	0	0	0	0	0	0	0
166	HSB6-11A				1 *	0	0	0	0	0	0	0
167	HSB6-11B				1 *	0	0	0	0	0	0	0
168	HSB6-12A				1 *	0	0	0	0	0	0	0
169	HSB6-12B				1 *	0	0	0	0	0	0	0
170	HSB6-212B	Duplicate of HSB6-12B #			1 *	0	0	0	0	0	0	0
171	HSB6-13A				1 *	0	0	0	0	0	0	0
172	HSB6-13B				1 *	0	0	0	0	0	0	0
173	HSB6-14A				1 *	0	0	0	0	0	0	0
174	HSB6-14B				1 *	0	0	0	0	0	0	0
175	HSB6-15A				1 *	0	0	0	0	0	0	0
176	HSB6-15B				1 *	0	0	0	0	0	0	0
177	HSB6-16A				1 *	0	0	0	0	0	0	0
178	HSB6-16B				1 *	0	0	0	0	0	0	0
179	HSB6-17A				1 *	0	0	0	0	0	0	0
180	HSB6-17B				1 *	0	0	0	0	0	0	0
181	HSB6-117B	Duplicate of HSB6-17B #			1 *	0	0	0	0	0	0	0
182	HSB6-18A	Request MS/MSD here			3 *	0	0	0	0	0	0	0

\*# = hide identity from laboratory

\*\*\* = Bottles will be provided by TARGET. \*X = Sample obtained from the brass ring of the VOA sample.

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)						[Analytical Parameter]	
					California brass ring	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar	8 oz glass soil jar
					(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)	(Cool to 4°C)
					[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]		
			DATE	TIME	brass ring 2 oz VOA			VOA S-VOA				
<b>FIELD SAMPLES – SITE</b>												
<b>FACILITY 1965:</b>												
183	HSB6-18B				1 *	0	0	0	0	0	0	0
184	HSB6-19A				1 *	0	0	0	0	0	0	0
185	HSB6-19B				1 *	0	0	0	0	0	0	0
186	HSB6-20A				1 *	0	0	0	0	0	0	0
187	HSB6-20B				1 *	0	0	0	0	0	0	0
188	MW6-4SA				1	1	0	X	0	1	0	0
189	MW6-4SB				1	1	0	X	0	1	0	0
190	MW6-5SA				1	1	0	X	0	1	0	0
191	MW6-5SB				1	1	0	X	0	1	0	0
192	MW6-15SB	Duplicate of MW6-5SB #			1	1	0	X	0	1	0	0
193	MW6-6SA				1	1	0	X	0	1	0	0
194	MW6-6SB				1	1	0	X	0	1	0	0
195	MW6-7SA				1	1	0	X	0	1	0	0
196	MW6-7SB				1	1	0	X	0	1	0	0
197	MW6-8RSA				1	1	0	X	0	1	0	0
198	MW6-8RSB				1	1	0	X	0	1	0	0
<b>SLUDGE WEATHERING LAGOON:</b>												
199	SD7-1					1	1	0	X	1	1	0
200	SD7-2					1	1	0	X	1	1	0
201	SD7-3					1	1	0	X	1	1	0
202	SD7-4					1	1	0	X	1	1	0
					98	77	167	108	0	160	167	94

\*# = hide identity from laboratory

\*\*\* = Bottles will be provided by TARGET. \*X = Sample obtained from the brass ring of the VOA sample.

TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)			[Analytical Parameter]		
			DATE	TIME	[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]
					40 mL VOA vial (HCl to pH<2; Cool to 4°C)	1 L amber glass (Cool to 4°C)	1 L amber glass (Cool to 4°C)	1 L amber glass (HCl to pH<2; Cool to 4°C)	1 L PE (HNO <sub>3</sub> to pH<2; Cool to 4°C)	1 L PE (NaOH to pH > 12; Cool to 4°C)
1	Site-day 1	SS1-16RN			1	1	1	1	1	1
2	Site-day 2	SS2-2RN			1	0	0	1	0	0
3	Site-day 3	SD1-7RN			1	1	1	1	1	1
4	Site-day 4	MW1-12DRN			1	1	1	1	1	1
5	Site-day 5	MW1-14DRN			1	1	1	1	1	1
6	Site-day 6	MW1-18RN			1	1	1	1	1	1
7	Site-day 7	MW1-22RN			1	1	1	1	1	1
8	Site-day 8	SB3-4RN			1	1	1	1	1	0
9	Site-day 1	MW4-4RN			1	1	0	1	1	0
10	Site-day 2	SB4-7RN			1	1	0	1	1	0
11	Site-day 3	MW5-5RN			1	1	0	0	1	0
12	Site-day 4	SS5-3RN			1	1	0	0	1	0
13	Site-day 5	MW6-4RN			1	1	0	1	0	0
14	Site-day 6	MW6-8RN			1	1	0	1	0	0
15	Site-day 7	SS3-4RN			1	1	1	1	1	0
TOTALS----->					15	14	8	13	13	6

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)			[Analytical Parameter]		
			DATE	TIME	[VOAs]	[SVOAs]	[Pest/PCBs]	[TPH]	[Metals, total]	[Cyanide]
					40 mL VOA vial (HCl to pH<2; Cool to 4°C)	1 L amber glass (Cool to 4°C)	1 L amber glass (Cool to 4°C)	1 L amber glass (HCl to pH<2; Cool to 4°C)	1 L PE (HNO <sub>3</sub> to pH<2; Cool to 4°C)	1 L PE (NaOH to pH > 12; Cool to 4°C)
1	Site-day 1	AMB- (&) ambient blank			1	0	0	0	0	0
2	Site-day 2	AMB- (&) ambient blank			1	0	0	0	0	0
3	Site-day 3	AMB- (&) ambient blank			1	0	0	0	0	0
4	Site-day 4	AMB- (&) ambient blank			1	0	0	0	0	0
5	Site-day 5	AMB- (&) ambient blank			1	0	0	0	0	0
6	Site-day 6	AMB- (&) ambient blank			1	0	0	0	0	0
7	Site-day 7	AMB- (&) ambient blank			1	0	0	0	0	0
					7	0	0	0	0	0

BOTTLES	
California Brass Rings	98
2 oz glass VOA soil jar	77
8 oz glass soil jar	696
40 mL VOA vial	35
1 L amber glass jar	35
1 L polyethylene bottles	20



TABLE 2-17

**SAMPLING PLAN DETAIL – SOIL AND SEDIMENT**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)								[Analytical Parameter]			
					[VOAs]		[SVOAs]		[Pest/PCBs]		[TPH]		[Metals, total]		[Cyanide]	
					DATE	TIME	AE	QA	AE	QA	AE	QA	AE	QA	AE	
<div>40 mL VOA vial (HCl to pH&lt;2; Cool to 4°C)</div> <div>1 L amber glass (Cool to 4°C)</div> <div>1 L amber glass (Cool to 4°C)</div> <div>1 L amber glass (HCl to pH&lt;2; Cool to 4°C)</div> <div>1 L PE (HNO<sub>3</sub> to pH&lt;2; Cool to 4°C)</div> <div>1 L PE (NaOH to pH &gt; 12; Cool to 4°C)</div>																
<b>TRIP BLANKS</b>																
1	Site-shipment 1 TB-_____	(&) trip blank			1		0		0		0		0		0	
2	Site-shipment 2 TB-_____	(&) trip blank			1		0		0		0		0		0	
3	Site-shipment 3 TB-_____	(&) trip blank			1		0		0		0		0		0	
4	Site-shipment 4 TB-_____	(&) trip blank			1		0		0		0		0		0	
5	Site-shipment 5 TB-_____	(&) trip blank			1		0		0		0		0		0	
6	Site-shipment 6 TB-_____	(&) trip blank			1		0		0		0		0		0	
7	Site-shipment 7 TB-_____	(&) trip blank			1		0		0		0		0		0	

\*& = Work will be filled in with date in the field.

TABLE 2-18A  
SAMPLING PLAN DETAIL – AQUEOUS  
Scott Air Force Base, Illinois

					Number and Type of Sample Containers (Preservative)				[Analytical Parameter]			
					40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 mL vial and 1 L amber glass	1 L PE	1 L PE	1 L PE
					(HCl to pH <2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH <2; Cool to 4 °C)	(HNO3 to pH <2; Cool to 4 °C)	(NaOH to pH > 12; Cool to 4 °C)	
LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		[Vol. Organics]	[Semivol. Orgs.]	[Pes/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]
					VOA S-VOA							
FIELD SAMPLES – SITE BACKGROUND:					** Full; no headspace							
1	MWB-1				3	2	2	2	3	2	1	1
2	MWB-1D				3	2	2	2	3	2	1	1
3	MWB-2				3	2	2	2	3	2	1	1
4	MWB-2D				3	2	2	2	3	2	1	1
5	SWB-1				3	2	2	0	3	2	1	1
6	SWB-2				3	2	2	0	3	2	1	1
7	SWB-3				3	2	2	0	3	2	1	1
LANDFILL:												
8	MW1-12				3	2	2	2	3	2	1	1
9	MW1-12D				3	2	2	2	3	2	1	1
10	MW1-13				3	2	2	2	3	2	1	1
11	MW1-113	Duplicate of MW1-13 #			3	2	2	2	3	2	1	1
12	MW1-13D				3	2	2	2	3	2	1	1
13	MW1-14				3	2	2	2	3	2	1	1
14	MW1-14D				3	2	2	2	3	2	1	1
15	MW1-15				3	2	2	2	3	2	1	1
16	MW1-15R				3	2	2	2	3	2	1	1
17	MW1-16				3	2	2	2	3	2	1	1
18	MW1-16D				3	2	2	2	3	2	1	1
19	MW1-17				3	2	2	2	3	2	1	1
20	MW1-18				3	2	2	2	3	2	1	1
21	MW1-19				3	2	2	2	3	2	1	1
22	MW1-119	Duplicate of MW1-19 #			3	2	2	2	3	2	1	1
23	MW1-20	Request MS/MSD here			9	6	6	6	9	6	3	3
24	MW1-21				3	2	2	2	3	2	1	1
25	MW1-22				3	2	2	2	3	2	1	1
26	MW1-23				3	2	2	2	3	2	1	1
27	MW1-4				3	2	2	2	3	2	1	1
28	MW1-7				3	2	2	2	3	2	1	1
29	MW1-9				3	2	2	2	3	2	1	1
30	MW1-10S				3	2	2	2	3	2	1	1
31	MW1-10D				3	2	2	2	3	2	1	1
32	MW1-11				3	2	2	2	3	2	1	1
33	MW1-111	Duplicate of MW1-11 #			3	2	2	2	3	2	1	1
34	SW1-7				3	2	2	0	3	2	1	1
35	SW1-8				3	2	2	0	3	2	1	1
36	SW1-9				3	2	2	0	3	2	1	1
37	SW1-10				3	2	2	0	3	2	1	1
38	SW1-11				3	2	2	0	3	2	1	1
39	HP1-1				3 *	0	0	0	0	0	0	0
FPTA No. 1:												
No water samples collected												
FPTA No. 2:												
39	MW3-2				3	2	2	0	3	2	1	1
40	MW3-3				3	2	2	0	3	2	1	1
41	MW3-4				3	2	2	0	3	2	1	1
42	MW3-5				3	2	2	0	3	2	1	1
*#* = hide identity from laboratory					*** = Vials will be provided by TARGET.							

\*# = hide identity from laboratory

\*\*\* = Vials will be provided by TARGET.

**TABLE 2-18A**  
**SAMPLING PLAN DETAIL – AQUEOUS**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)				[Analytical Parameter]				
					40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 mL vial and 1 L amber glass	1 L PE	1 L PE	1 L PE	
					(HCl to pH <2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH <2; Cool to 4 °C)	(HNO3 to pH <2; Cool to 4 °C)	(NaOH to pH >12; Cool to 4 °C)		
			DATE	TIME	[Vol. Organics]	[Semivol. Orgs.]	[Pest/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]	
					** Full; no headspace								
FIELD SAMPLES - SITE													
FPTA No. 3:													
43	MW4-1				3	2	0	0	0	0	1	0	0
44	MW4-2				3	2	0	0	0	0	1	0	0
45	MW4-4				3	2	0	0	0	0	1	0	0
46	MW4-4D				3	2	0	0	0	0	1	0	0
47	MW4-5	Request MS/MSD here			9	6	0	0	0	0	3	0	0
48	MW4-6				3	2	0	0	0	0	1	0	0
49	MW4-16	Duplicate of MW4-6 #			3	2	0	0	0	0	1	0	0
50	HP4-1				3*	0	0	0	0	0	0	0	0
51	HP4-2				3*	0	0	0	0	0	0	0	0
52	HP4-3				3*	0	0	0	0	0	0	0	0
53	HP4-4				3*	0	0	0	0	0	0	0	0
54	HP4-5				3*	0	0	0	0	0	0	0	0
55	HP4-6				3*	0	0	0	0	0	0	0	0
56	HP4-7				3*	0	0	0	0	0	0	0	0
57	HP4-8				3*	0	0	0	0	0	0	0	0
58	HP4-9				3*	0	0	0	0	0	0	0	0
59	HP4-10				3*	0	0	0	0	0	0	0	0
60	HP4-110	Duplicate of HP4-10 #			3*	0	0	0	0	0	0	0	0
61	HP4-11				3*	0	0	0	0	0	0	0	0
62	HP4-12				3*	0	0	0	0	0	0	0	0
63	HP4-13				3*	0	0	0	0	0	0	0	0
64	HP4-14				3*	0	0	0	0	0	0	0	0
65	HP4-15				3*	0	0	0	0	0	0	0	0
66	HP4-16				3*	0	0	0	0	0	0	0	0
67	HP4-17				3*	0	0	0	0	0	0	0	0
68	HP4-18				3*	0	0	0	0	0	0	0	0
69	HP4-19				3*	0	0	0	0	0	0	0	0
70	HP4-20				3*	0	0	0	0	0	0	0	0
71	HP4-120	Duplicate of HP4-20 #			3*	0	0	0	0	0	0	0	0
72	HP4-21	Request MS/MSD here			9*	0	0	0	0	0	0	0	0
73	HP4-22				3*	0	0	0	0	0	0	0	0
74	HP4-23				3*	0	0	0	0	0	0	0	0
75	HP4-24				3*	0	0	0	0	0	0	0	0
76	HP4-25				3*	0	0	0	0	0	0	0	0
77	HP4-26				3*	0	0	0	0	0	0	0	0
78	HP4-27				3*	0	0	0	0	0	0	0	0
79	HP4-28				3*	0	0	0	0	0	0	0	0
80	HP4-29				3*	0	0	0	0	0	0	0	0
81	HP4-30				3*	0	0	0	0	0	0	0	0
82	HP4-130	Duplicate of HP4-30 #			3*	0	0	0	0	0	0	0	0
FACILITY 8550:													
83	MW5-4				3	2	0	0	0	2	1	0	1
84	MW5-5				3	2	0	0	0	2	1	0	1
85	MW5-6				3	2	0	0	0	2	1	0	1
86	SW5-1				3	2	0	0	0	2	1	0	1

\*\*\* = hide identity from laboratory

\*\*\* = Vials will be provided by TARGET.

TABLE 2-18A  
SAMPLING PLAN DETAIL - AQUEOUS  
Scott Air Force Base, Illinois

					Number and Type of Sample Containers (Preservative)				[Analytical Parameter]				
					40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 mL vial and 1 L amber glass	1 L PE	1 L PE	1 L PE	
					(HCl to pH <2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH <2; Cool to 4 °C)	(HNO3 to pH <2; Cool to 4 °C)	(NaOH to pH > 12; Cool to 4 °C)		
LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		[Vol. Organics]	[Semivol. Orgs.]	[Pest/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]	
					VOA		S-VOA						
FIELD SAMPLES - SITE					** Full; no headspace								
FACILITY 8550:													
87	SW5-2				3	2	0	0	0	2	1	0	1
88	SW5-3				3	2	0	0	0	2	1	0	1
89	SW5-4				3	2	0	0	0	2	1	0	1
90	SW5-5				3	2	0	0	0	2	1	0	1
91	HP5-1				3 *	0	0	0	0	0	0	0	0
92	HP5-2				3 *	0	0	0	0	0	0	0	0
93	HP5-22	Duplicate of HP5-2 #			3 *	0	0	0	0	0	0	0	0
94	HP5-3	Request MS/MSD here			9 *	0	0	0	0	0	0	0	0
95	HP5-4				3 *	0	0	0	0	0	0	0	0
96	HP5-5				3 *	0	0	0	0	0	0	0	0
97	HP5-6				3 *	0	0	0	0	0	0	0	0
98	HP5-7				3 *	0	0	0	0	0	0	0	0
99	HP5-8				3 *	0	0	0	0	0	0	0	0
100	HP5-9				3 *	0	0	0	0	0	0	0	0
101	HP5-10				3 *	0	0	0	0	0	0	0	0
102	HP5-11				3 *	0	0	0	0	0	0	0	0
103	HP5-12				3 *	0	0	0	0	0	0	0	0
104	HP5-112	Duplicate of HP5-12 #			3 *	0	0	0	0	0	0	0	0
105	HP5-13				3 *	0	0	0	0	0	0	0	0
106	HP5-14				3 *	0	0	0	0	0	0	0	0
107	HP5-15				3 *	0	0	0	0	0	0	0	0
108	HP5-16				3 *	0	0	0	0	0	0	0	0
109	HP5-17				3 *	0	0	0	0	0	0	0	0
110	HP5-18				3 *	0	0	0	0	0	0	0	0
111	HP5-19				3 *	0	0	0	0	0	0	0	0
112	HP5-20				3 *	0	0	0	0	0	0	0	0
113	HP5-21				3 *	0	0	0	0	0	0	0	0
114	HP5-22				3 *	0	0	0	0	0	0	0	0
115	HP5-122	Duplicate of HP5-22 #			3 *	0	0	0	0	0	0	0	0
116	HP5-23				3 *	0	0	0	0	0	0	0	0
117	HP5-24				3 *	0	0	0	0	0	0	0	0
118	HP5-25				3 *	0	0	0	0	0	0	0	0
119	HP5-26				3 *	0	0	0	0	0	0	0	0
120	HP5-27				3 *	0	0	0	0	0	0	0	0
121	HP5-28				3 *	0	0	0	0	0	0	0	0
122	HP5-29				3 *	0	0	0	0	0	0	0	0
123	HP5-30				3 *	0	0	0	0	0	0	0	0
FACILITY 1965:													
124	HP6-1				3 *	0	0	0	0	0	0	0	0
125	HP6-2				3 *	0	0	0	0	0	0	0	0
126	HP6-22	Duplicate of HP6-2 #			3 *	0	0	0	0	0	0	0	0
127	HP6-3	Request MS/MSD here			9 *	0	0	0	0	0	0	0	0
128	HP6-4				3 *	0	0	0	0	0	0	0	0
129	HP6-5				3 *	0	0	0	0	0	0	0	0
130	HP6-6				3 *	0	0	0	0	0	0	0	0
131	HP6-7				3 *	0	0	0	0	0	0	0	0

\*# = hide identity from laboratory

\*\*\* = Vials will be provided by TARGET.

TABLE 2-18A  
SAMPLING PLAN DETAIL – AQUEOUS  
Scott Air Force Base, Illinois

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)				[Analytical Parameter]				
					40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 mL vial and 1 L amber glass	1 L PE	1 L PE	1 L PE	
					(HCl to pH <2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH <2; Cool to 4 °C)	(HNO3 to pH <2; Cool to 4 °C)	(NaOH to pH > 12; Cool to 4 °C)	(Cool to 4 °C)	
					[Vol. Organics]	[Semivol. Orgs.]	[Pest/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]	
					** Full; no headspace				VOA S-VOA				
FIELD SAMPLES - SITE FACILITY 1985:													
132	HP6-8				3 *	0	0	0	0	0	0	0	0
133	HP6-9				3 *	0	0	0	0	0	0	0	0
134	HP6-10				3 *	0	0	0	0	0	0	0	0
135	HP6-11				3 *	0	0	0	0	0	0	0	0
136	HP6-12				3 *	0	0	0	0	0	0	0	0
137	HP6-112	Duplicate of HP6-12 #			3 *	0	0	0	0	0	0	0	0
138	HP6-13				3 *	0	0	0	0	0	0	0	0
139	HP6-14				3 *	0	0	0	0	0	0	0	0
140	HP6-15				3 *	0	0	0	0	0	0	0	0
141	HP6-16				3 *	0	0	0	0	0	0	0	0
142	HP6-17				3 *	0	0	0	0	0	0	0	0
143	HP6-18				3 *	0	0	0	0	0	0	0	0
144	HP6-19				3 *	0	0	0	0	0	0	0	0
145	HP6-20				3 *	0	0	0	0	0	0	0	0
146	MW6-4				3	2	0	0	3	0	1	0	1
147	MW6-2				3	2	0	0	3	0	1	0	1
148	MW6-5				3	2	0	0	3	0	1	0	1
149	MW6-15	Duplicate of MW6-5 #			3	2	0	0	3	0	1	0	1
150	MW6-6	Request MS/MSD here			9	6	0	0	9	0	3	0	3
151	MW6-7				3	2	0	0	3	0	1	0	1
152	MW6-8R				3	2	0	0	3	0	1	0	1
SLUDGE WEATHERING LAGOON:													
153	HP7-1				3 *	0	0	0	0	0	0	0	0
154	HP7-2				3 *	0	0	0	0	0	0	0	0
155	HP7-3				3 *	0	0	0	0	0	0	0	0
156	HP7-4				3 *	0	0	0	0	0	0	0	0
157	HP7-5				3 *	0	0	0	0	0	0	0	0
158	HP7-6				3 *	0	0	0	0	0	0	0	0
159	HP7-7				3 *	0	0	0	0	0	0	0	0
160	HP7-8				3 *	0	0	0	0	0	0	0	0
161	HP7-9				3 *	0	0	0	0	0	0	0	0
162	HP7-10				3 *	0	0	0	0	0	0	0	0
163	HP7-11				3 *	0	0	0	0	0	0	0	0
164	HP7-12				3 *	0	0	0	0	0	0	0	0
165	HP7-13				3 *	0	0	0	0	0	0	0	0
166	HP7-14				3 *	0	0	0	0	0	0	0	0
167	HP7-15				3 *	0	0	0	0	0	0	0	0
168	HP7-16				3 *	0	0	0	0	0	0	0	0
169	HP7-17				3 *	0	0	0	0	0	0	0	0
170	HP7-18				3 *	0	0	0	0	0	0	0	0
171	HP7-19				3 *	0	0	0	0	0	0	0	0
172	HP7-119	Duplicate of HP7-19 #			3 *	0	0	0	0	0	0	0	0
173	HP7-20	Request MS/MSD here			9 *	0	0	0	0	0	0	0	0
174	SW7-1				3	2	0	0	3	1	1	0	1
175	SW7-2				3	2	0	0	3	1	1	0	1
176	SW7-3				3	2	0	0	3	1	1	0	1
177	SW7-4				3	2	0	0	3	1	1	0	1
					222	148	88	64	171	108	74	40	65
*# = hide identity from laboratory					*** = Vials will be provided by TARGET.								

TABLE 2-18A  
SAMPLING PLAN DETAIL - AQUEOUS  
Scott Air Force Base, Illinois

					Number and Type of Sample Containers (Preservative)				[Analytical Parameter]			
					40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 mL vial and 1 L amber glass	1 L PE	1 L PE	1 L PE
					(HCl to pH <2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH <2; Cool to 4 °C)	(HNO3 to pH <2; Cool to 4 °C)	(NaOH to pH > 12; Cool to 4 °C)	
LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		[Vol. Organics]	[Semivol. Orgs.]	[Pest/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]
			DATE	TIME					VOA	S-VOA		
					** Full; no headspace							
FIELD QC SAMPLES												
1	Site-day 1	MWB-2DRN	rinsate		3	2	2	0	2	2	1	1
2	Site-day 2	MW1-13DRN	rinsate		3	2	2	2	2	2	1	1
3	Site-day 3	MW1-15RRN	rinsate		3	2	2	2	2	2	1	1
4	Site-day 4	MW1-18RN	rinsate		3	2	2	2	2	2	1	1
5	Site-day 5	MW1-21RN	rinsate		3	2	2	2	2	2	1	1
6	Site-day 6	MW1-7RN	rinsate		3	2	2	2	2	2	1	1
7	Site-day 7	MW1-11RN	rinsate		3	2	2	2	2	2	1	1
8	Site-day 8	SW1-10RN	rinsate		3	2	2	0	2	2	1	1
9	Site-day 9	MW4-5RN	rinsate		3	2	2	0	2	2	1	1
10	Site-day 10	MW5-6RN	rinsate		3	2	2	0	0	2	1	1
11	Site-day 11	SW5-5RN	rinsate		3	2	0	0	0	2	1	1
12	Site-day 12	MW6-7RN	rinsate		3	2	0	0	2	0	1	1
13	Site-day 13	MW6-4RN	rinsate		3	2	0	0	2	0	1	1
1	Site-day 1	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
2	Site-day 2	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
3	Site-day 3	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
4	Site-day 4	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
5	Site-day 5	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
6	Site-day 6	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
7	Site-day 7	AMB- (8)ambient blank			2	0	0	0	0	0	0	0
TOTALS----->					53	26	20	12	22	22	13	10

**TABLE 2-18B**  
**SAMPLING PLAN DETAIL - AQUEOUS**  
**Scott Air Force Base, Illinois**

LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION		Number and Type of Sample Containers (Preservative)				[Analytical Parameter]			
			DATE	TIME	40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 mL vial and 1 L amber glass	1 L PE	1 L PE	1 L PE
					(HCl to pH<2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH<2; Cool to 4 °C)	(HNO3 to pH<2; Cool to 4 °C)	(NaOH to pH>12 (Cool to 4 °C)	
					[Vol. Organics]	[Semivol. Orgs.]	[Pest/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]
									VOA S-VOA			
FIELD SAMPLES - SITE BACKGROUND:					** Full; no headspace							
1	MWB-1	Request MS/MSD			9	6	6	6	9 6	3	3	3
2	MWB-1D				3	2	2	2	3 2	1	1	1
3	MWB-2				3	2	2	2	3 2	1	1	1
4	MWB-12	Duplicate of MWB-2 #			3	2	2	2	3 2	1	1	1
5	MWB-2D				3	2	2	2	3 2	1	1	1
6	SWB-1				3	2	2	0	3 2	1	1	1
					24	16	16	14	24 16	8	8	8
*# = hide identity from laboratory												
FIELD QC SAMPLES												
1	Site-day 1	MWB-2DRN	rinsate		3	2	2	2	3 2	1	1	1
2	Site-day 1	AMB-_____ (&) ambient blank			2	0	0	0	0 0	0	0	0
					5	2	2	2	3 2	1	1	1
TOTALS----->												
<div style="border: 1px solid black; padding: 5px; display: inline-block;">           BOTTLES            40 mL vials 56            1 L amber glass 70            1 L PE 27         </div>												
TRIP BLANKS												
1	Site-shipment 1	TB-_____ (&) trip blank			2	0	0	0	0 0	0	0	0

\*& = blank to be filled in with date in the field

TABLE 2-18C

**SAMPLING PLAN DETAIL – AQUEOUS**  
**Scott Air Force Base, Illinois**

					Number and Type of Sample Containers (Preservative)				[Analytical Parameter]				
					40 mL vial **	1 L amber glass	1 L amber glass	1 L amber glass	40 ml VOA and 1 L amber glass	1 L PE	1 L PE	1 L PE	
					(HCl to pH<2; Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(Cool to 4 °C)	(HCl to pH<2; Cool to 4 °C)	(HNO3 to pH<2; Cool to 4 °C)	(NaOH to pH> 12; Cool to 4 °C)	(Cool to 4 °C)	
					[Vol. Organics]	[Semivol. Orgs.]	[Pest/PCBs]	[Explosives]	[TPH]	[Metals, total]	[Cyanide]	[TDS]	
									VOA S-VOA				
					** Full; no headspace								
LOCATION	SAMPLE ID	COMMENT	SAMPLING INFORMATION										
			DATE	TIME									
FIELD SAMPLES – SITE BACKGROUND:													
1	MWB-1	Request MS/MSD			9	6	6	6	9	6	3	3	3
2	MWB-1D				3	2	2	2	3	2	1	1	1
3	MWB-2				3	2	2	2	3	2	1	1	1
4	MWB-12	Duplicate of MWB-2 #			3	2	2	2	3	2	1	1	1
5	MWB-2D				3	2	2	2	3	2	1	1	1
6	SWB-1				3	2	2	0	3	2	1	1	1
					24	16	16	14	24	16	8	8	8
*#* = hide identity from laboratory													
FIELD QC SAMPLES													
1	Site-day 1	MWB-2DRN	rinsate		3	2	2	2	3	2	1	1	1
2	Site-day 1	AMB-_____ (&) ambient blank			2	0	0	0	0	0	0	0	0
TOTALS----->					5	2	2	2	3	2	1	1	1
<div><div>BOTTLES</div><div>40 mL vials56</div><div>1 L amber glass70</div><div>1 L PE27</div></div>													
TRIP BLANKS													
1	Site-shipment 1	TB-_____ (&) trip blank			2	0	0	0	2	0	0	0	0

\*#\* = blank to be filled in with date in the field



Sampling Report with other sample information gathered during sampling. Other field parameters include safety measurements of air vapors and turbidity during well development.

### 2.3.2 Equipment Calibration

All equipment will be calibrated according to manufacturers instructions or a generally accepted practice. Calibration of all instruments will be recorded in the field book. The following subsections describe calibration procedures.

- Field pH will be measured with an Orion pH meter. The instrument will be field-calibrated with pH 4 and pH 7 buffer solutions at the beginning and middle of each day's use. Accuracy of the measurement is maintained by selecting a standard buffer with a pH as close as possible to that of the sample (preferably within three pH units). The pH of the buffers used is dependent upon the pH of the sample, but in each case will "bracket" the range of measurement. The pH probe will be rinsed with reagent water between each use. The pH instrument user's guide is presented in Appendix A.
- Temperature and specific conductivity will be measured with a portable YSI (Yellow Springs Instrument) S-C-T (Salinity, Conductivity, Temperature) meter. Calibration of the instrument is periodically performed at the factory as part of Law's internal QA program. The instrument probe will be rinsed with reagent water between each use and calibration checked at the beginning of each day's use. The instrument is standardized in the field, using deionized water and KCl solutions with known conductance. The YSI equipment manual is presented in Appendix B.
- The hand held portable organic vapor analyzer used to screen the air vapors at the head of the augers and in the breathing

zone will be calibrated daily with a 100 ppm level of isobutylene. The battery power supply will be recharged each evening prior to the next day drilling operation and instrument use. The HNu equipment manual is presented in Appendix C.

The turbidimeter will be calibrated daily with 0.1 NTU Standard. This instrument will be used during the development of the well to determine ground-water clarity.

The manual is presented in Appendix D.

#### 2.3.3 Equipment Maintenance

Equipment used in the field is located in a central store room. The equipment must be "signed in" upon return and "signed out" when removed for use in the field.

All equipment must be returned decontaminated and any malfunctions reported to the project manager. The project manager will incorporate any actions necessary for the repair or replacement of the equipment. Equipment maintenance logs are kept on file in the chemistry department.

#### 2.3.4 Decontamination

The following decontamination procedures will apply to split spoons, hand augers, stainless-steel bowls and spoons, stainless-steel beakers, and ground-water bailers. The decontamination steps are as follows:

- 1) Hand wash with bristle brush and a solution of Alconox (or equivalent);
- 2) Rinse with copious quantities of potable water;

- 3) Rinse with deionized (Reagent Grade II) water;
- 4) Spray-rinse with pesticide grade methanol;
- 5) Spray-rinse with pesticide grade hexane;
- 6) Air dry.

The following procedure shall be used to decontaminate large pieces of equipment such as drill rigs, auger flights, and casing.

- 1) Wash the external surface of equipment or materials with high-pressure hot water and Alconox or equivalent, and scrub with brushes if necessary until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been rinsed from the equipment into the 1500-gallon collection tank.
- 2) Air dry. The sampling equipment will be cleaned prior to each use in accordance with this procedure. All decontamination solutions will be stored in 1300-gallon tanks and maintained at the site until analyses have been completed.

## 2.4 FIELD QA/QC PROGRAM

### 2.4.1 Control Parameters

Control parameters of the field procedures consist of the same controls that govern analytical data. These parameters are controlled through the assessment of data by precision, accuracy, representativeness and completeness. Control parameters consist of the following:

- Collection of field and QC samples
- Calibration of field equipment

- Decontamination of field equipment
- Development of wells
- Purging a minimum of 3 well volumes before sampling
- Record Keeping

#### 2.4.2 Control Limits and Corrective Actions

Table 2-19 presents a summary of Field Quality control procedures, acceptance criteria and corrective actions.

### 2.5 RECORD KEEPING

Pertinent information will be recorded in the hard bound field notebook, and all chain-of-custody documents completed. The bound field notebook will have pre-numbered pages, and entries will be made in indelible ink. Data from the sampling episode will also be recorded on the Law field sampling form shown in Figure 2-14. Each day the site manager will prepare a Daily Quality Control Report (DQCR) and send it to the ESO/ER TPM.

The DQCR will include weather information at the time of sampling, samples collected, field instruments and calibrations and will reflect any problems that occurred in the field. A DQCR is shown in Figure 2-15.

### 2.6 SITE MANAGEMENT

The AFCEE Technical Program Manager (TPM) for Scott AFB Stage 2 RI/FS is Mr. John F. Wauters. Mr. Wauter's address and phone number are:

TABLE 2-19

**FIELD CORRECTIVE ACTION PROCEDURES**  
**Scott Air Force Base, IL**

SITUATION	CALIBRATION	FREQUENCY	FIELD OBJECTIVE AFFECTED	CORRECTIVE ACTION PROCEDURE
Equipment malfunction				
pH	- Calibrated with two buffer solutions that bracket expected sample pH	- Before well purging and before final value is measured	Equipment is calibrated and operating properly.	- Notification of site supervisory personnel - Repair or replace malfunctioning parts
SC	- Calibrate with two standards in expected range of sample SC	- Daily		- Recalibrate and/or replace standards - Resample or repeat task if necessary - Document to Project Manager
Temperature	- Calibrate within expected temperature range of samples	- Monthly		
Turbidity	- Calibrate within expected range of sample turbidity	- Daily		
Incorrect sample collection procedures	NA	NA	Samples are taken according to standard operating procedures.	- Notification of site supervisory personnel - Review of situation and correct procedures - Document to Project Manager
Insufficient sample volume collection	NA	NA	Sufficient sample volume is provided to maintain sample integrity and so that all required analyses can be conducted.	- Notification of site supervisory personnel by laboratory manager - Review site affected and impact of samples on site characterization correct procedures - Document to Project Manager and AFCEE TPM
Incorrect measurement data collection	NA	NA	Measurements are conducted according to standard operating procedures	- Notification of site supervisory personnel - Review of situation and correct procedures - Document to Project Manager and QAO

# FIELD SAMPLING REPORT



FIGURE 2-14

**LAW ENVIRONMENTAL, INC.**  
GOVERNMENT SERVICES DIVISION  
KENNESAW, GEORGIA

JOB No. \_\_\_\_\_  
JOB NAME \_\_\_\_\_  
DATE \_\_\_\_\_ TIME \_\_\_\_\_  
SAMPLING POINT \_\_\_\_\_  
(LOCATION) \_\_\_\_\_  
DEPTH \_\_\_\_\_

## SAMPLE INFORMATION

SAMPLE I.D. NO.: \_\_\_\_\_

MATERIAL: \_\_\_\_\_ WATER \_\_\_\_\_ SOIL \_\_\_\_\_ SLUDGE \_\_\_\_\_ OTHER (LIST) \_\_\_\_\_

TYPE: \_\_\_\_\_ GRAB \_\_\_\_\_ COMPOSITE \_\_\_\_\_ OTHER (LIST) \_\_\_\_\_

HAZARDOUS?: \_\_\_\_\_ YES \_\_\_\_\_ NO \_\_\_\_\_ UNKNOWN

CONTAINER		NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
TYPE	VOLUME			

COMMENTS: (WELL PURGING VOLUME: SAMPLE APPEARANCE; ODOR; COLOR, ETC.)

## FIELD MEASUREMENTS

PARAMETER	EQUIPMENT I.D.	RESULTS (UNITS)	COMMENTS

COMMENTS: (CALIBRATIONS, FIELD MODIFICATIONS, INSTRUMENT PROBLEM)

## GENERAL INFORMATION

WEATHER \_\_\_\_\_ AIR TEMPERATURE \_\_\_\_\_

SAMPLES SHIPPED TO: \_\_\_\_\_

SPECIAL HANDLING: \_\_\_\_\_

MODE OF SHIPMENT: \_\_\_\_\_ CAR/TRUCK \_\_\_\_\_ BUS \_\_\_\_\_ PLANE \_\_\_\_\_ COMMERCIAL VEHICLE

## QA/QC

SAMPLE COLLECTED BY: \_\_\_\_\_ SAMPLING OBSERVED BY: \_\_\_\_\_

DISCREPANCIES: \_\_\_\_\_

FIGURE 2-15  
**DAILY QUALITY CONTROL REPORT**

REPORT No. \_\_\_\_\_ CONTRACT No. \_\_\_\_\_ DATE \_\_\_\_\_

LOCATION OF WORK \_\_\_\_\_

DESCRIPTION OF WORK \_\_\_\_\_

WEATHER \_\_\_\_\_ RAINFALL (INCHES) \_\_\_\_\_ TEMPERATURE \_\_\_\_\_ MIN \_\_\_\_\_ MAX

WIND DIRECTION \_\_\_\_\_

1. WORK PERFORMED \_\_\_\_\_

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2. SAMPLES COLLECTED \_\_\_\_\_

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3. PERSONNEL AND VISITORS AT SITE \_\_\_\_\_

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SITE MANAGER: \_\_\_\_\_



**LAW ENVIRONMENTAL, INC.**  
GOVERNMENT SERVICES DIVISION

HF

AFCEE/ESR  
Brooks AFB, TX 78235-5000  
(512) 536-9001  
AV 240-9001  
1-800-821-4528  
ext. 216

The Scott AFB Point of Contact (POC) is Mr. Tim Tedesco. His address and phone numbers are:

AEDC/DEV  
Scott AFB, IL  
(618) 256-4165/576-4165

Mr. Tim Tedesco will assist in base cooperation for the following:

- Locate underground utilities and issue digging or other appropriate permits to the IRP contractor prior to the commencement of digging or drilling operations.
- Assign accumulation points within the installation to which the contractor can deliver any drill cuttings or well installation/ development fluids generated from the required work which are suspected to be hazardous. The contractor is responsible for providing all necessary containers (55-gallon drums) and for transporting the containerized material to the accumulation point. Determine and specify to the contractor the rate at which the containerized materials should be transported to assigned accumulation points.
- Assign accumulation points within the installation to which the contractor can transport and empty containerized materials determined not to be hazardous.



- Take custody of any drill cuttings, well installation/development fluids, or decontamination fluids suspected to be hazardous and properly dispose of the material according to applicable state and/or federal regulations.
- Provide the contractor with existing engineering plans, drawings, diagrams, aerial photographs, digitized map files, etc., to facilitate evaluation of IRP sites under investigation.
- Arrange for the following:
  - a. Personnel identification badges, vehicle passes, and/or entry permits. Law will provide names of personnel involved at the site to Tim Tedesco prior to field activities. All personnel are U.S. citizens.
  - b. A staging area (approximately 1000 square feet) for storing equipment and supplies.
  - c. A supply (e.g., two 1500-gallon portable tanks) of large quantities of potable water for borehole flushing, equipment cleaning, etc.



1

**APPENDIX A**

**Fisher Accumet Model 956  
PORTABLE ANALOG ph/mV METER**

# Instructions

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**Fisher  
Accumet®  
Model 956  
Portable Analog  
pH/mV Meter**

**Catalog No. 13-636-956**

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 **Fisher Scientific**

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## UNPACKING

The Accumet Model 956 is shipped in a single carton containing the items listed below. While unpacking, check each item against the packing list. If a shortage exists, notify your representative, giving the name and number of the missing item. Also be sure to complete and return the warranty card located at the rear of this manual.

**NOTE:** In the event that shipping damage has been observed, retain the carton and packing material intact with the unit and file a claim with the final carrier. Usually, the firm will send an inspector to ascertain liability.

Quantity	Item	Cat. No. or Part No.
1	Accumet Portable pH Meter Assembly	69368
	Containing:	
1	Accumet pH Meter	13-620-956
1	Beaker, 100mL	41951
1	pH-9 Bottle	31222
1	pH-4 Bottle	31223
1	Thermometer	31142
1	Support Rod	41831
1	Electrode Holder	19941
1	Battery	40367
1	Combination Electrode	13-620-108
1	Instruction Manual	69369

## OPERATING CONTROLS

Prior to using the Model 956, become familiar with the location and function of each control and connector. All are located inside the case (see figure 1) and are described in detail below:

**Readout Meter.** An analog meter with a pH scale covering 0-14 pH units, and a millivolt scale covering  $\pm 700$  millivolts. The scales are graduated in 0.1 pH and 10 millivolt increments, respectively, and are mirrored to minimize parallax errors.

**Mechanical Meter Zero.** A screwdriver adjustment that mechanically zeros the meter pointer. With the instrument sitting on a flat, level surface, the adjustment must be made with the FUNCTION selector in the OFF position to avoid electrical deflection of the pointer.

**FUNCTION Selector.** A three-position rotary switch used to disconnect battery power (OFF position) when measurements are not being taken, and to select the operating mode: pH for pH determinations and MV for millivolt measurements.

**TEMPERATURE Control.** A potentiometer that functions only in the pH mode to compensate for the effects of solution temperature on the electrode. The control is continuously variable from 0° to 100°C with a scale graduated in 2° increments.

**STANDARDIZE Control.** A multi-turn potentiometer that is used in pH determinations to set the meter to the pH value of a buffer solution, thereby compensating for the differences in the zero potential of electrode systems. In millivolt and redox measurements, the control establishes the millivolt zero reference point on the meter.

**INPUT Jack.** A jack that receives the BNC lead from the combination electrode, or any lead from an indicator electrode with a BNC connector.

**NOTE:** If an indicator electrode with a pin jack is to be used, the pin jack adapter Cat. No. 13-620-490 should be connected to the meter.

**REF Jack.** A jack that receives any single-lead from a reference electrode with a pin connector.

**Support Mounting Socket.** A threaded socket (immediately to right of TEMPERATURE control) which accepts the electrode support rod when instrument is in operation.

## Checking and Adjusting Meter Zero

Before initial use, the mechanical zero of the meter movement must be checked and, if necessary, adjusted. The meter pointer should indicate precisely 7 pH (or zero millivolts) with the FUNCTION selector set to OFF. If the above conditions are not met, adjust the MECHANICAL ZERO, using a small screwdriver, until specified indication is obtained.

## Installing pH Electrode System

The Model 956 is supplied with a plastic-body combination electrode that is especially suited to the rugged conditions associated with field work. The INPUT and REF jacks will accommodate all other indicator and reference electrodes that employ BNC and pin cable connectors, respectively. The supplied electrode holder contains openings for one or two standard size electrode caps.

**NOTE:** At this point, the electrode(s) should be properly conditioned according to the manufacturer's instructions.

To install the supplied combination electrode, perform the following:

1. Unsnap the support rod from its molded case compartment and screw (clockwise) the threaded end into the socket in the meter panel.
2. Install electrode holder (see Figure 2) on support rod by depressing plate on underside of holder, sliding holder onto support rod, and releasing plate.
3. Remove the plastic cot from the tip of the electrode.
4. Slip electrode body into slot on either side of holder and lower it until cap is firmly seated.
5. Observe that FUNCTION selector is set to OFF, then remove shorting cap from the BNC jack.
6. Insert the round BNC connector jack onto the INPUT jack.
7. Check electrode system efficiency by standardizing in a buffer of known value and measuring in a second buffer by generally following the Standardizing Instrument and Performing pH Determinations procedures in the OPERATION section.
8. The electrode is now installed and ready for use (see OPERATION section). When not in use store the electrode as directed by the following procedure.

## OPERATION

Separate procedures are provided below for standardizing the instrument, for performing pH measurements, and for performing millivolt measurements. Note that in all the procedures that follow, the FUNCTION selector should always be in the OFF position when immersing or removing the electrode system from solution. This practice avoids meter fluctuations that may damage the movement. Also the FUNCTION selector must always be set to OFF when the instrument is not in use to avoid unnecessary battery drain.

## Performing Millivolt Determinations

The Model 956 is a convenient tool for measuring electrode potential and indicating results over a -700 to +700 millivolt range. There is no need to standardize the instrument with a buffer or compensate for solution temperature. Readings can be taken as soon as the millivolt zero reference point is established, with no further standardization necessary.

Assuming that the electrodes are conditioned and installed according to instructions from manufacturer, a millivolt measurement is made as follows:

1. Be certain that **FUNCTION** selector is set to **OFF**.
2. Connect the shorting cap to the **INPUT** jack.
3. Turn **FUNCTION** selector to **MV** position and adjust **STANDARDIZE** control until meter indicates zero millivolts (or any other desired value).
4. Turn **FUNCTION** selector to **OFF**, remove jumper, and connect electrode leads to **INPUT** and **REF** jacks.
5. Place sample container in case compartment directly beneath electrode system, then lower electrode system into sample solution.  
**NOTE:** Always locate sample container in compartment provided to avoid damage from spillage.
6. Turn **FUNCTION** selector to **MV** and read electrical potential of solution directly from meter.
7. Turn **FUNCTION** selector to **OFF**.
8. Remove electrodes from sample and rinse them with distilled water.
9. Repeat steps 7 through 10 for remaining samples.
10. Upon completing final determination each day, be certain that **FUNCTION** selector is in **OFF** position.

## SERVICE

Solid-state components and easily accessible assemblies simplify servicing of the Model 956. The following information is given to aid qualified service personnel and help minimize downtime. The information includes a brief circuit description, a troubleshooting guide, procedures to check instrument performance, buffer accuracy, electrode system efficiency, a procedure to remove the meter panel, and calibration and checking procedures. Also included at the end of the manual are replacement parts and a schematic. In addition, Fisher Scientific Company maintains a company wide Instrument Service Division with fully staffed service centers to assist with any service problems.

## Understanding the Circuit

A single, operational amplifier in the Model 956 circuitry provides the necessary high-impedance input as well as the amplification required to drive the analog meter. This and the use of three diodes in the reference circuit facilitates meter indication of either polarity as well as excellent battery voltage stability over the entire instrument range.



## Checking Instrument Performance

While performing the following procedure, there should be little, if any, drift and fluctuation in the meter needle in either the pH or mV mode. The presence of drift and/or fluctuation indicates an instrument defect. Instrument performance is checked as follows:

1. Connect shorting cap to the INPUT jack. (This shorts instrument input.)
2. Set FUNCTION Selector to pH position.
3. Set TEMPERATURE Control to 25°C.
4. Adjust STANDARDIZE Control until meter indicates 7.0 pH.
5. Turn STANDARDIZE Control to full clockwise and full counterclockwise positions: meter should indicate at least 4.0 and 10.0 pH respectively.  
**NOTE:** This demonstrates that STANDARDIZE Control has sufficient range to compensate for the zero potential of electrode systems.
6. Set FUNCTION Selector to MV.
7. It should be possible to adjust STANDARDIZE Control until meter indicates 0.0 millivolts (center scale).

## Checking Buffer Accuracy

The most practical way to check buffer accuracy is to substitute a questionable bottle of buffer with a fresh, unused bottle. Some buffers deteriorate with age, but contamination is the principal cause of inaccuracy. A common practice is to regularly use two buffers — one as a working buffer and one as a check buffer.

## Checking Electrode System Efficiency

Once instrument performance and buffer accuracy are found to be satisfactory, check efficiency of electrode system as follows:

1. Install combination electrode.
2. Obtain two buffer solutions that are several pH units apart in the 3 to 10 pH range.
3. Standardize the instrument with one of the buffers (as directed by Standardizing Instrument procedure given in the OPERATION section).
4. Determine the pH value of the other buffer (as directed by Performing pH Determinations procedure in the OPERATION section).

**NOTE:** The result of this determination should be within 0.1 pH units of the known buffer value. If it is not, repair or replace the electrode system.

## Removing Meter Panel

Most service procedures, such as battery and component replacement, require that the meter panel be removed from the case. This can be accomplished quickly and easily as follows:

1. Set FUNCTION Selector to OFF.
2. Disconnect electrode system from meter.
3. Remove electrode and electrode holder from support rod, then unscrew rod from meter panel.
4. Remove the four screws (two along each side) securing meter panel to carrying case, then lift panel up and out of case.
5. All components are mounted to rear of panel and are now easily accessible for service.

## Calibration

The Model 956 is factory calibrated to perform within the stated pH and MV specifications. Under normal conditions, this calibration will yield satisfactory results over a long time period. However, it is recommended that the instrument be recalibrated annually or after any circuit component (except battery) has been replaced. An internal component view of the meter is shown in figure 2.

## Calibrating pH Scale and Temperature Control

The pH value of a solution is generally dependent upon temperature; hence, the accuracy of a pH scale is dependent upon the accuracy of the TEMPERATURE Control. Consequently, both these components are calibrated in conjunction with each other as follows:

**NOTE:** It is recommended that the mV calibration procedure be completed before calibrating the pH scale. Therefore, the procedure given below assumes that meter panel is not secured to the case and that the millivolt source is still connected to the INPUT jack.

1. Set millivolt source to 00.00 or disconnect source and connect shorting cap to the INPUT jack.
2. Turn FUNCTION Selector to pH and, if necessary, readjust STANDARDIZE Control until meter indicates exactly 7.00 pH.
3. Rotate TEMPERATURE Control to full clockwise and full counterclockwise positions. Knob pointer should approximately align with the 0 to 100°C scale markings. If not, loosen the two knob setscrews and realign knob until above specifications are met.
4. Set TEMPERATURE Control to 25°C.
5. Connect millivolt source to INPUT jack (if disconnected in step 1) and adjust millivolt source to supply an output of +295.785 millivolts.
6. The meter should indicate  $2.0 \pm 0.3$  pH. If not, adjust R10 on circuit board until correct indication is obtained.
7. Reverse polarity of millivolt source.
8. Meter should indicate  $12.0 \pm 0.3$  pH. If not, readjust R10 until meter indicates midway between noted reading and correct reading.

**NOTE:** If desired, Model 956 pH scale can be calibrated using buffers. In this case, instrument should be first standardized with a pH 7.00 buffer and then calibrated using a pH 4.00 and adjusting R10.

9. Reassemble instrument by generally reversing steps 1 through 3 under Removing Meter Panel.

## Replacement Parts

The replacement parts, along with their location drawings, are provided in this section. The section is arranged in assembly to subassembly breakdown. That is, the highest order assembly appears first, followed by its subassembly make up. Non-field repairable assemblies or subassemblies are not broken down into their component parts. Note that parts information is only valid at the publication date (see back cover) of this manual, and subsequent revisions may have occurred after publication.



**APPENDIX B**

**YSI MODELS 33 AND 33M S-C-T METERS INSTRUCTIONS**

# YSI MODELS 33 AND 33M S-C-T METERS INSTRUCTIONS



## GENERAL DESCRIPTION

The YSI Model 33 and 33M S-C-T Meters are portable, battery powered, transistorized instruments designed to accurately measure salinity, conductivity and temperature. They use a probe consisting of a rugged, plastic conductivity cell and a precision YSI thermistor temperature sensor combined in a single unit.

Conductivity with the Model 33 is expressed as micro-mhos/centimeter; with the 33M, it is millisiemens/meter (mS/m). These are measurements of the electrical conductance the sample would show if measured between opposite faces of a 1 cm cube. (Conversion information: 1 microhm/cm = 0.1 mS/m.) Salinity is the number of grams of salt/kilogram of sample (ppt = parts per thousand). This measurement assumes the sample contains a "standard" sea water salt mixture. The sample temperature is measured in degrees Celsius.

Salinity measurements are annually temperature compensated by direct dial. Conductivity measurements are not temperature compensated; however, a temperature function is provided on the instrument to aid with calculation of corrections. When temperature and conductivity are known, it is possible to calculate salinity; and when only temperature and salinity are known, it is possible to calculate conductivity. This is discussed in the section on Recalibration.

## SPECIFICATIONS

### Model 33 Conductivity

Range: 0 to 500 ( $\times 1$ ), 0 to 5,000 ( $\times 10$ ), and 0 to 50,000 microhm/cm ( $\times 100$ ) with YSI 3300 Series Probes. (Note: The "microhm" designations on the meter are a shorthand form for "microhm/cm".)

Accuracy: (See Error Section)  
 $\pm 2.5\%$  max. error at 500, 5,000 and 50,000 plus probe.  
 $\pm 3.0\%$  max. error at 250, 2,500 and 25,000 plus probe.

### Readability:

2.5 microhm/cm on 500 microhm/cm range.  
 25 microhm/cm on 5,000 microhm/cm range.  
 250 microhm/cm on 50,000 microhm/cm range.

Temperature Compensation: None.

### Model 33M Conductivity

#### Range:

0 to 50 ( $\times 1$ ), 0 to 500 ( $\times 10$ ), and 0 to 5,000 ( $\times 100$ ) mS/m with YSI 3300 Series Probes.

#### Accuracy: (See Error Section)

$\pm 2.5\%$  max. error at 50, 500, and 5,000 plus probe.  
 $\pm 3.0\%$  max. error at 25, 250, and 2,500 plus probe.

### Readability:

0.25 mS/m on 50 mS/m range.  
 2.5 mS/m on 500 mS/m range.  
 25.0 mS/m on 5,000 mS/m range.

Temperature Compensation: None.

### Salinity

Range: 0-40 ppt in temperature range of  $-2$  to  $+45^{\circ}\text{C}$  within specified conductivity range of 0 to 50,000 microhm/cm (0 to 5,000 mS/m). See chart in section Recalibration.

#### Accuracy (See Error Section)

Above  $4^{\circ}\text{C}$ :  $\pm 0.9$  ppt at  $40$  ppt and  $\pm 0.7$  ppt at  $20$  ppt plus conductivity probe.

Below  $4^{\circ}\text{C}$ :  $\pm 1.1$  ppt at  $40$  ppt and  $\pm 0.9$  ppt at  $20$  ppt plus conductivity probe.

Readability: 0.2 ppt on 0-40 ppt range.

Temperature Compensation: Manual by direct dial to  $-2$  to  $+45^{\circ}\text{C}$ .

Temperature Range:  $-2$  to  $+45^{\circ}\text{C}$ .

Accuracy:  $\pm 0.1^{\circ}\text{C}$  at  $-2^{\circ}\text{C}$ ,  $\pm 0.6^{\circ}\text{C}$  at  $45^{\circ}\text{C}$  plus probe (See Error Section)

Readability:  $\pm 0.15^{\circ}\text{C}$  at  $-2^{\circ}\text{C}$  to  $\pm 0.37^{\circ}\text{C}$  at  $45^{\circ}\text{C}$ .

Power Supply: Two D-size alkaline batteries. Eveready or equivalent, provide approximately 200 hours operation.

Instrument Ambient Range:  $-5$  to  $+45^{\circ}\text{C}$ . A maximum of  $\pm 0.1\%$  of the reading per  $^{\circ}\text{C}$  change in instrument temperature can occur. This error is negligible if instrument is readjusted to redline for each reading.



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The salinity readings are a function of temperature and conductivity, therefore the accuracy is a function of both.

Salinity Reading	% of Seedling (P. communis)	% of Seedling (P. maritima)
0	100	100
5	100	100
10	80	90
15	10	25
20	0	20

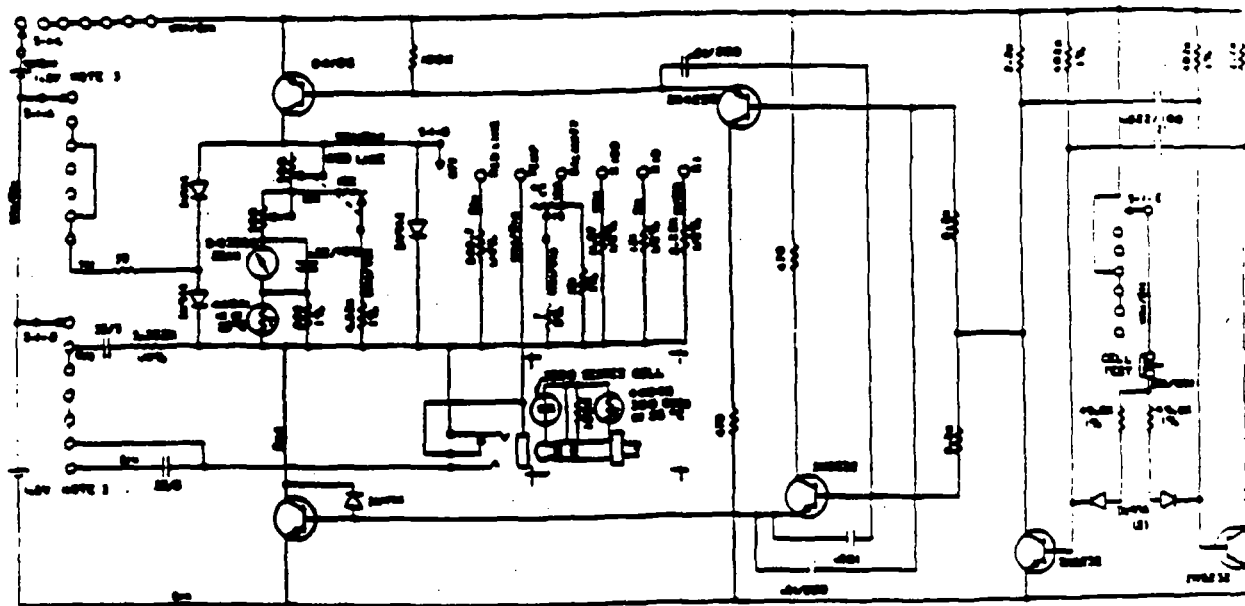
**INDEX 1**

Example  
Water Reading: 10 ppt. @ 10°C  
% of Reading Error: 6.50  
Accuracy: 10 ppt.  $\pm 0.65$  ppt for all errors.  
combined worst case.

The circuit is composed of two parts: a multivibrator and switching transistors. The multivibrator produces a square waveform voltage. The square wave is applied to two switching transistors. They alternately apply two batteries of opposite polarity to the probe thus providing AC power which eliminates polarization effects. The meter is in series with one battery and measures the current from it. The current from the battery is proportional to the conductance of the cell. Salinity is measured in a special range conductivity circuit which includes a user-adjusted temperature compensator. In the temperature, redline and 11 positions, the multivibrator operates at 100Hz. In the salinity, X100 and X10 positions the multivibrator operates at 600Hz; in these ranges, pushing the TEST button drops the frequency to 100Hz, allowing the operator to test for probe polarization.

The only maintenance required is battery replacement. Two "D" size alkaline flashlight cells, such as Eveready E95 or equivalent, will provide 200 hrs. of operation. Accuracy will not be maintained if zinc-carbon "D" cells are used. Battery replacement is indicated when the redline adjustment cannot be accomplished.

Replace batteries every six months to reduce the danger of corrosion due to leaky batteries. To replace batteries, remove the screws from the rear cover. The battery holders are color coded. The positive end must be on an red.



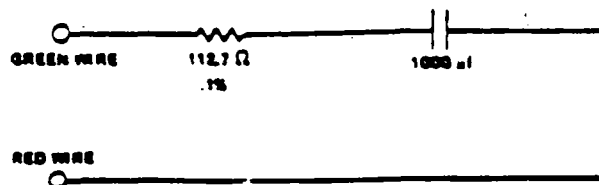
Battery is D size, alkaline only. Eveready 1-95 or equivalent.

**Y31 MODEL 11 AND 11E SCHEMATIC**

2. You may use the resistor and capacitor hookup shown in the sketch to substitute for the probe in the following recalibration procedure.

- Set the instrument for a salinity measurement as normal.
- Substitute a 1000 microfarad capacitor and 112.7 ohm 0.1% tolerance resistor for the probe.

Connect the resistor and capacitor between the green wire and red wire on the jack connections inside the instrument.



c. Turn the temperature dial until the meter reads redline.

d. Reinstall the temperature knob with the arrow at 25°C.

This is a temporary calibration only. Return the instrument to the factory for proper recalibration.

#### YSI 3300 SERIES CONDUCTIVITY/TEMPERATURE PROBES

##### Description

These probes are designed and constructed for rugged, accurate service in field use. The conductivity cell constant is 9.0/cm (500.0/Ω) ±3%. Each probe contains a precision YSI thermometer temperature sensor of ±0.1°C accuracy at 0°C and ±0.3°C at 40°C. The low capacitance cable assembly terminates in a three terminal 0.25" dia. phone plug.

The 3310 has a 10 foot cable and the 3311 a 30 foot cable. Other lengths are available on special order.

The probe has a rigid P.V.C. body, platinized pure nickel electrodes, and a rugged cable.

##### Cleaning and Storage

###### Cleaning

When the cell test indicates low readings the probable cause is dirty electrodes. Hard water deposits, oils and organic matter are the most likely contaminants.

For convenient normal cleaning soak the electrodes for 5 minutes with a locally available bathroom tile cleaning preparation such as Bow Chemical "Bathroom and Chrome Cleaner," Johnson Wax "Wax," Instant Cleaner," or Lysol Brand "Bath, Tub, Tile Cleaner."

For stronger cleaning a 5 minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol and 1 part HCl can be used.

Always rinse the probe thoroughly in tap water, then in distilled or deionized water after cleaning and before storage.

**CAUTION:** Do not touch the electrodes inside the probe. Platinum black is soft and can be scraped off.

If cleaning does not restore the probe performance replatinizing is required.

##### Storage

It is best to store conductivity cells in deionized water. Cells stored in water require less frequent platinization. Any cell that has been stored should be soaked in deionized water for 24 hours before use.

##### Replatinization

1. Clean the probe.

2. Place the cell in a 50 ml (approximate) jar beaker and add enough YSI 3140 Platinizing Solution to cover the electrodes. Do not cover the top of the probe.

3. Plug the probe into the Model 33 or 33H, switch the K100 scale to platinize the electrodes. Move the probe slightly to obtain the highest meter reading and continue platinizing for the approximate time shown below:

Meter Reading microhm/cm	Time in minutes	
	μS/cm	
30,000	1,000	5
25,000	1,500	6
20,000	2,000	8
15,000	1,500	11
10,000	1,000	16

4. After the elapsed time, remove the probe and rinse in tap water, then in distilled or deionized water.

5. Return the solution to its container. 2 oz. of solution should be sufficient for 50 treatments.

##### Probe Use and Precautions

1. Obstructions near the probe can disturb reading. At least two inches of clearance must be allowed from non-metallic underwater objects. Metallic objects such as piers or weights should be kept at least 6 inches from the probe.

2. Weights are attached to the cable of the YSI 3310 and 3311 Probes. The YSI 3327 Weights are supplied in pairs with a total weight of 4 ounces per pair. Should it become necessary to add more weight to overcome water currents, we suggest limiting the total weight to two pounds (8 pairs). For weights in excess of two pounds use an independent suspension cable. In either case, weights must be kept at least 6 inches away from the probe.

3. Gentle agitation by raising and lowering the probe several times during a measurement insures flow of specimen solution through the probe and improves the time response of the temperature sensor.

##### Conductivity and Salinity Corrections for Long Cables

The additional length of wire in long cables adds capacitance and resistance which will affect readings. The recommended way to correct for these influences is by use of YSI Conductivity Calibrator Solutions (see below), which will permit an estimate of correction factors. If these solutions are not available, the following tables can be used for the correction of errors caused by cable resistance and capacitance. Special length versions of the 3310, 3311, 3-1793 and 3-16120 probes.



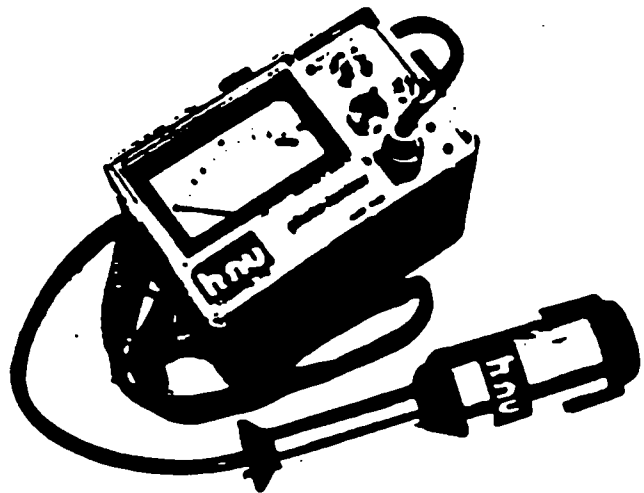


**APPENDIX C**

**INSTRUCTION MANUAL FOR  
MODEL PI 101 PHOTOIONIZATION ANALYZER**



INSTRUCTION MANUAL  
FOR  
MODEL PI 101  
PHOTOIONIZATION ANALYZER



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## SECTION 1

### INTRODUCTION

The model PI 101 has been designed to measure the concentration of trace gases in many industrial or plant atmospheres. The analyzer employs the principle of photoionization for detection. This process is termed photoionization since the absorption of ultraviolet light (a photon) by a molecule leads to ionization via:



where RH = trace gas

$h\nu$  = a photon with an energy  $\geq$  Ionization Potential of RH

The sensor consists of a sealed ultraviolet light source that emits photons which are energetic enough to ionize many trace species (particularly organics) but do not ionize the major components of air such as  $O_2$ ,  $N_2$ ,  $CO$ ,  $CO_2$ , or  $H_2O$ . A chamber adjacent to the ultraviolet source contains a pair of electrodes. When a positive potential is applied to one electrode, the field created drives any ions, formed by absorption of UV light, to the collector electrode where the current (proportional to concentration) is measured.

To minimize adsorption of various sample gases, the ion chamber is made of an inert fluorocarbon material, is located at the sampling point, and a rapid flow of sample gas is maintained through the small ion chamber volume.

The analyzer will operate either from a rechargeable battery for more than 10 hours or continuously from the AC battery charger. A solid state amplifier board in the probe and a removable power supply board in the readout module enable rapid servicing of the unit in the field.

TABLE 1  
SPECIFICATIONS FOR MODEL PI 101  
PHOTOIONIZATION ANALYZER

performance (benzene referred)

range 0.1 to 2000 ppm  
detection limit 0.1 ppm  
sensitivity (max) 0-2 ppm FSD over 100 division meter scale  
repeatability  $\pm 1\%$  of FSD  
linear range 0.1 to 600 ppm  
useful range 0.1 to 2000 ppm  
response time  $< 3$  sec to 90% of full scale  
ambient humidity to 95% RH  
operating temperature ambient to 40°C\*

physical

size: probe 6.3 DIA x 28.5L (cm)	(2-1/2 x 11-1/4")
readout 21W x 13D x 16.5H (cm)	(8-1/4 x 5-3/16 x 6-1/2")
stowed 21W x 13D x 24H (cm)	(8-1/4 x 5-3/16 x 9-1/2")
cable 80 cm long (32")	

weight: probe .55 kg (20 ounces)  
readout 3.2 kg (7 pounds)  
total (shipping) 5.4 kg (12 pounds)

controls and functions

mode switch Off, Battery Check, Standby (zero), 0-2000, 0-200, 0-20 ppm  
low battery indicator light  
zero (10 turn  $\pm 300\%$  FSD max)  
span (10 turn counting dial 1.0 to 10 times nominal sensitivity)  
readout 4-1/2" (11.3 cm) meter Tact Band movement graduated 0-5-10-15-20.  
divisions  
signal output for recorder 0-(-5V) FSD  
power output for recorder 12 VDC - jack on side of instrument

power requirements of operating times

continuous use, battery  $> 10$  hours  
continuous use with HNU recorder reduces instrument battery operating time  
to 1/2 normal time  
recharge time, max  $< 14$  hours, 3 hours to 90% of full charge  
recharge current, max .4 Amps @ 15 VDC

## SECTION 2

### OPERATION

#### 2.1 Unpacking

Unpack the instrument carefully and remove the housing, the probe and any spare parts from the shipping carton. Place the instrument on a table or bench with the label upright. Remove the top section of the instrument by opening the two fasteners on the cover (see figure 1). The inner panel of the top section can be removed by pulling up on the fasteners. The top section of the instrument contains the battery charger and a waist strap. The waist strap clips on to the strap brackets of the instrument when needed.

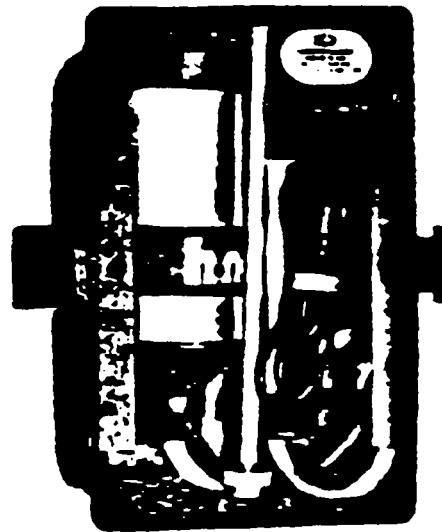
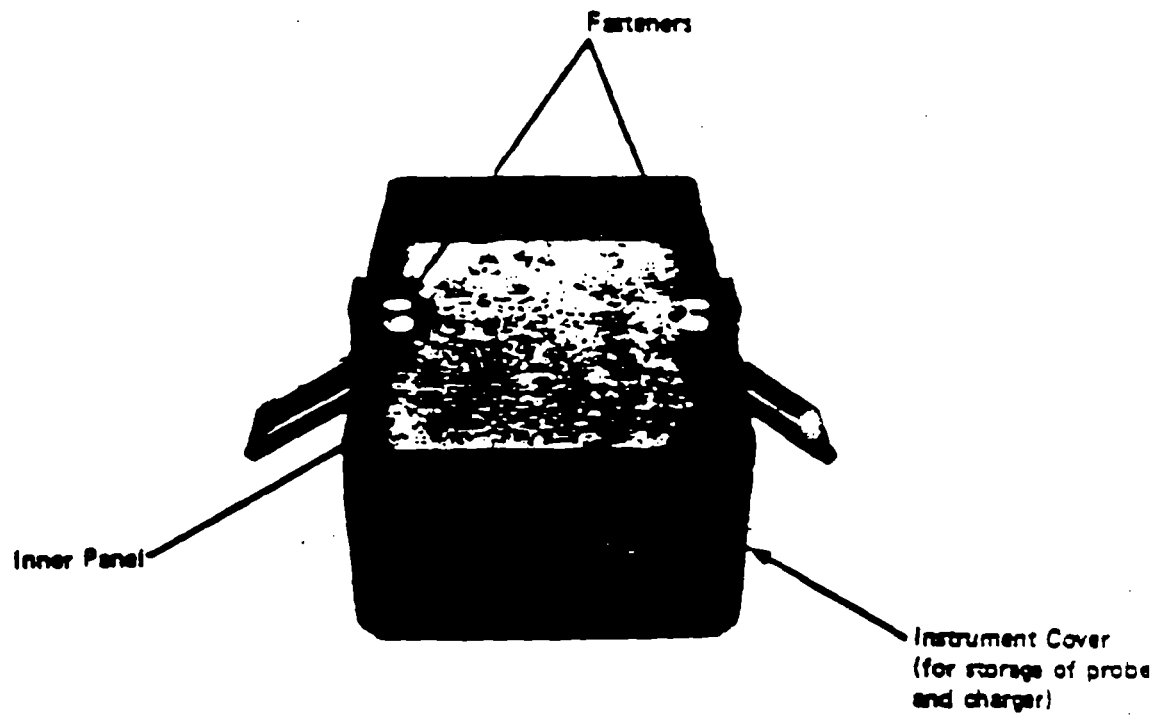
Before attaching the probe, check the function switch on the control panel to make sure it is in the off position. The 12 pin interface connector for the probe is located just below the span adjustment on the face of the instrument (see figure 2). Carefully match the Alignment Key in the probe connector to the 12 pin connector on the control panel, and then twist the probe connector until a distinct snap and lock is felt.

Attached to the instrument is a warranty card which should be filled out completely and returned to HNU Systems.

#### 2.2 Operation

Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery arc on the scaleplate. If the needle is in the lower portion of the battery arc, the instrument should be recharged prior to making any measurements. If red LED comes on, the battery should be recharged.

Figure 1 (Continued)



Top View

TABLE II  
BRIEF DESCRIPTION OF INSTRUMENT  
CONTROLS AND FUNCTIONS\*

Control	Function
Six Position Switch	<p>OFF - Shuts off all power and removes DC voltage.</p> <p>ON - In any other function position or neutral mode, the electronics are on.</p> <p>BATTERY CHECK - Indicates the condition of battery. If needle position is in low portion of green battery arc, the instrument should be recharged.</p> <p>STANDBY - UV Lamp is off but electronics are on. This position will conserve power and increase the useful operating time between recharges of the battery. This position is also utilized to adjust the electronic zero.</p> <p>RANGES - 0-20, 0-200, 0-2000 direct reading available at minimum gain for benzene. sensitivity is available by adjusting span potentiometer.</p>
Zero Potentiometer	A ten turn potentiometer is employed to adjust the zero electronically when the instrument is placed in the standby position with the probe attached. This eliminates the need for a high carbon free gas.
Span Potentiometer	A ten turn counting potentiometer is utilized for upscale setting of the meter on calibration. Counter-clockwise rotation increases the sensitivity (~10 times). This pot can increase the sensitivity to make the instrument direct read nearly any gas which the instrument responds to.

\*For position of layout controls see Figure 2.

To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counterclockwise rotation yields a downscale deflection. Note: no zero gas is needed, since this is an electronic zero adjustment (see below). If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 or 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero.

The instrument is now ready for calibration or measurement by switching the function switch to the proper measurement range. The instrument is supplied calibrated to read directly in ppm (v/v) 0-20, 0-200, 0-2000 of benzene with the span position set at 9.8. For additional sensitivity, the span potentiometer is turned counterclockwise (smaller numbers) to increase the gain. By changing the span setting from 10.0 to 1.0 the sensitivity is increased approximately ten fold. Then, the 0-20, 0-200, and 0-2000 ppm scales become 0-2, 0-20, and 0-200 ppm full scale, respectively. This span control is also utilized to make the instrument scale read directly in ppm of the compound being measured. E.g., it is adjusted to match the value of a calibration gas to that same reading on the instrument scale. The span control can be utilized to calibrate nearly any compound, measured by photoionization, to be direct reading on the 0-20 ppm range. For example, gain settings of 4.5 or 8.9, respectively, will provide direct reading capability (0-20, 0-200 ppm) for vinyl chloride and trichloroethylene, respectively. For a listing of approximate gain setting values see Table IV.



TABLE III

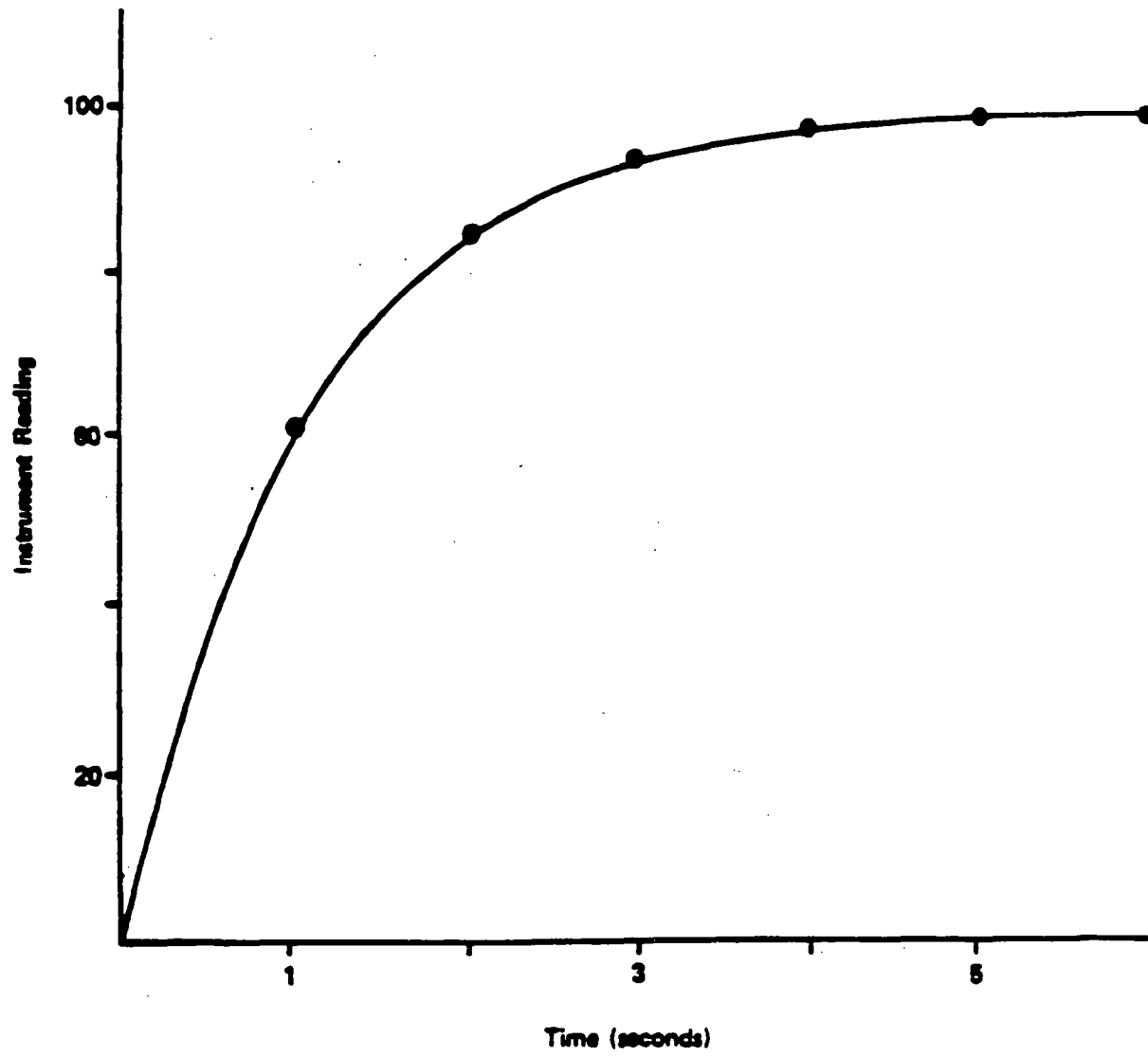
VERIFICATION OF ELECTRONIC ZERO FOR  
PHOTOIONIZATION ANALYZER\*

Sample	Instrument Reading (ppm)	% of F.S.
Room Air	0.7	35
Room Air Passed Through 6" x 3/4" OD Charcoal Scrubber	0.1	5
Zero Air	0.25	12.5
Zero Air Passed Through 6" x 3/4" OD Charcoal Scrubber	0.04	2

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\*Maximum Gain = 2 ppm full scale.

Figure 3. Time Response for the Photoionization Analyzer.



To charge the battery, place the mini phone plug into the jack on left side of the bezel prior to plugging charger into 120 VAC. When disconnecting charger, remove from 120 VAC before removing mini phone plug. The battery is completely recharged overnight (ca. 14 hours). To ensure that the charger is functioning, turn the function switch to the battery check position, place phone plug into jack and plug charger into AC outlet. The meter should go upscale if charger is working and is correctly inserted into the jack.

The instrument can be operated during the recharge cycle. This will lengthen the time required to completely recharge the instrument battery.

### SECTION 3

#### CALIBRATION

Static or dynamic gas generation systems can be utilized for calibration of the instrument. A number of such systems for generating test atmospheres for various gases have been described by G. O. Nelson in "Controlled Test Atmospheres," Ann Arbor Science Publishers, Ann Arbor, Michigan (1971).

The most convenient packages for calibration are the non-toxic analyzed gas mixtures available from HNU Systems in pressurized containers (Catalogue #101-350 ).

A rapid procedure for calibration involves bringing the probe and readout in close proximity to the calibration gas, cracking the valve on the tank and checking the instrument reading. This provides a useful spot check for the instrument.

The recommended and most accurate procedure for calibration of the instrument from a pressurized container is to connect one side of a 'T' to the pressurized container of calibration gas, another side of the 'T' to a rotameter and the third side of the 'T' directly to the 8" extension to the photoionization probe (see Figure 5). Crack the valve of the pressurized container until a slight flow is indicated on the rotameter. The instrument draws in the volume of sample required for detection, and the flow in the rotameter indicates an excess of sample. Now adjust the span pot so that the instrument is reading the exact value of the calibration gas. (If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted if necessary.)

The calibration gas\* should be prepared in the same matrix (air, nitrogen, hydrogen, etc.) in which it is to be measured, otherwise an inaccurate reading may be obtained. The increased response which is seen in oxygen free gases can be attributed to a reduction in the quenching of ions by oxygen (actually  $O_2^-$ ) and is typical of any ionization detector. The quenching effect of oxygen is constant from about ten percent  $O_2$  to very high levels.

If a gas standard prepared in nitrogen is to be used for measurements in air, fill a 0.5 or 1 liter bag with the standard then add 50 or 100 cc of pure oxygen to bring the level to 10-12%.

Any error between this value and 20% oxygen is quite small.

If the sample to be measured is in nitrogen, standards should be prepared in nitrogen. This will result in an increase in sensitivity of approximately 4.

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\* Calibration with toxic gases should be performed in a hood since the 101 is a non-destructive analyzer.

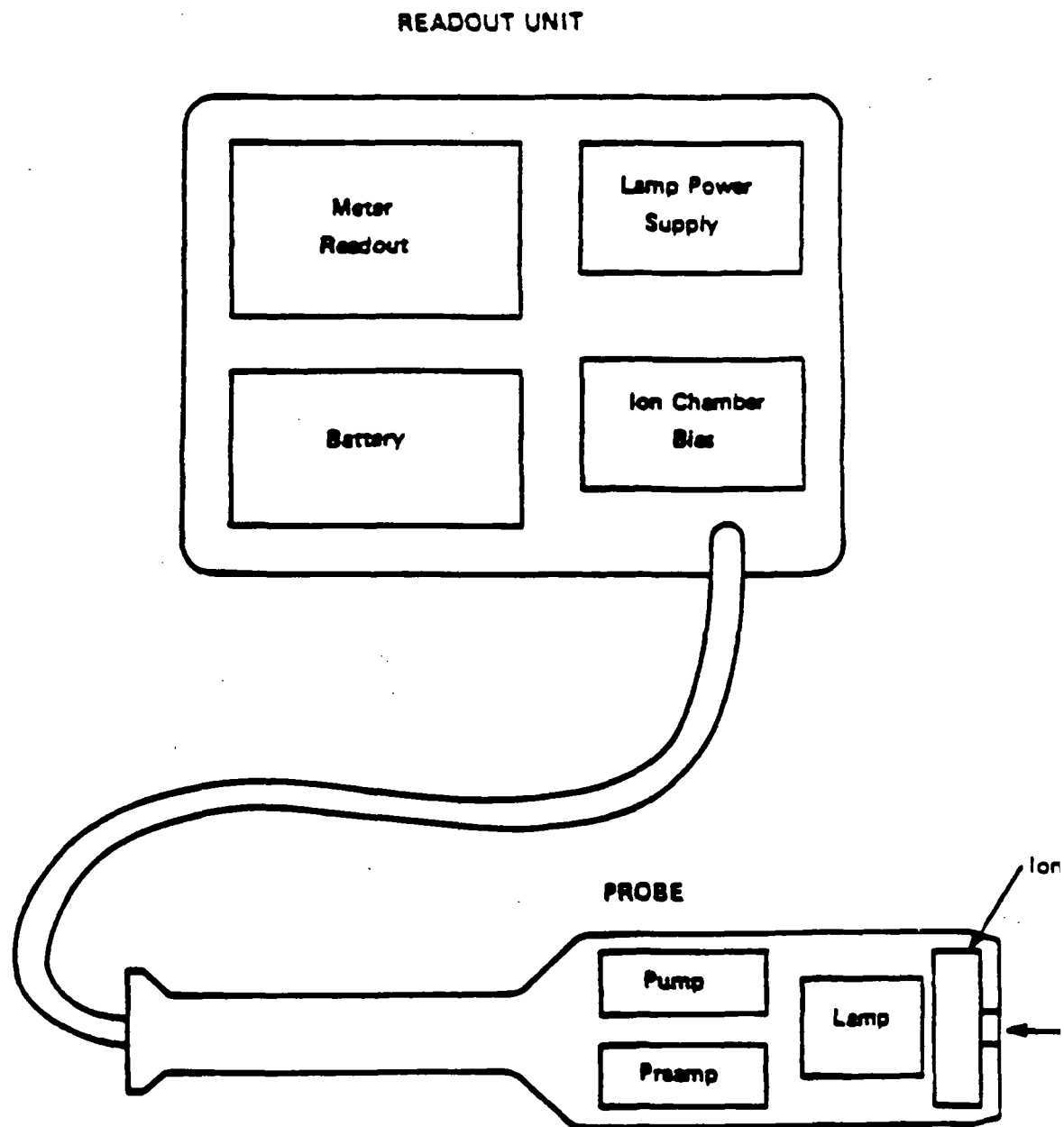
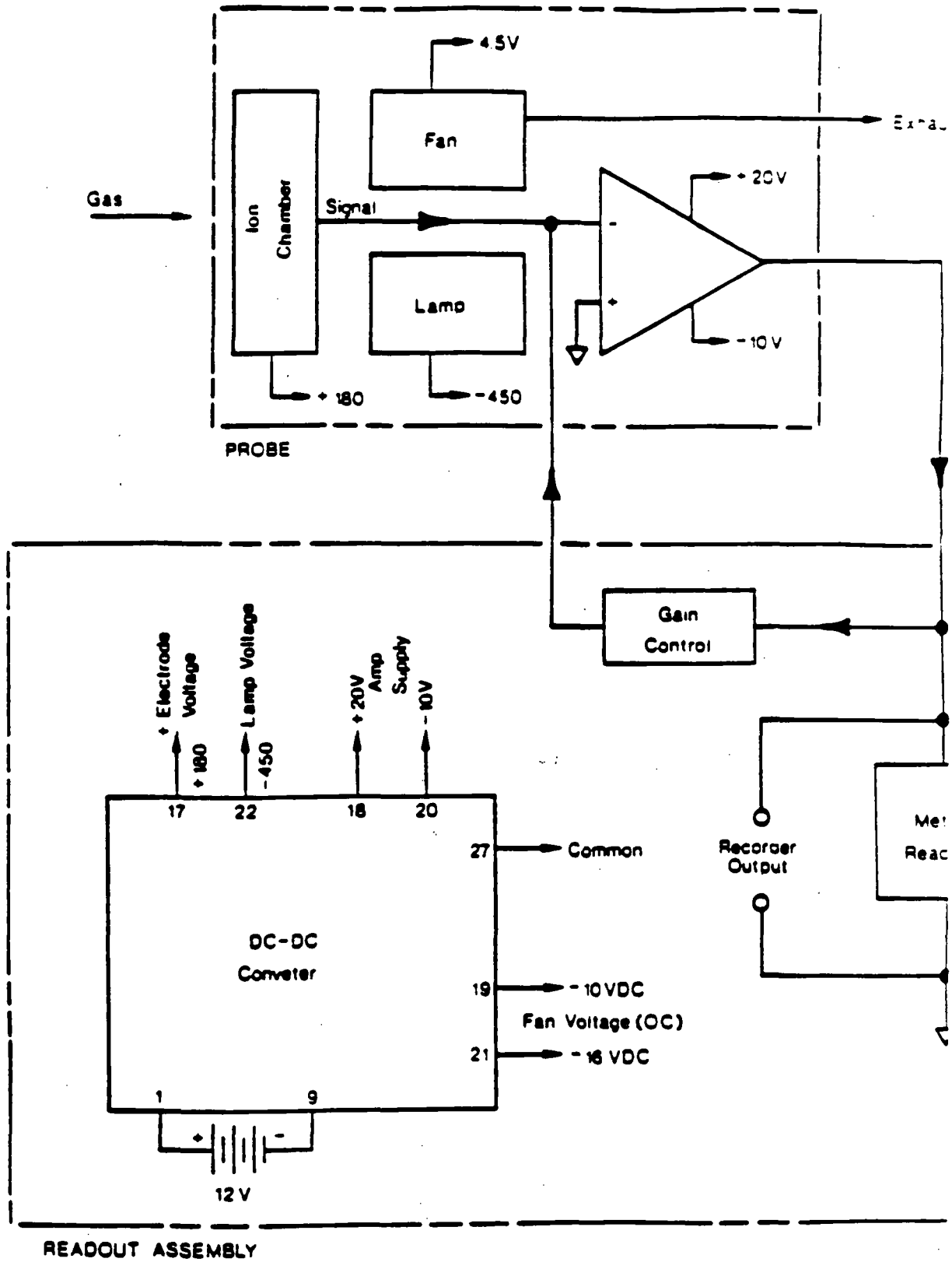


Figure 6. Block Diagram of Portable Photoionization Analyzer.

Figure 7. Electrical Block Diagram of Photoionization Analyzer



**TABLE VI**  
**PARAFFINS AND CYCLOPARAFFINS**

<b>Molecule</b>	<b>IP (eV)</b>
methane	12.98
ethane	11.65
propane	11.07
n-butane	10.63
i-butane	10.57
n-pentane	10.35
i-pentane	10.32
2,2-dimethylpropane	10.35
n-hexane	10.18
2-methylpentane	10.12
3-methylpentane	10.08
2,2-dimethylbutane	10.06
2,3-dimethylbutane	10.02
n-heptane	10.08
2,2,4-trimethylpentane	9.86
cyclopropane	10.06
cyclopentane	10.53
cyclohexane	9.88
methylcyclohexane	9.85



TABLE VII (Continued)

Molecule	IP (eV)
1-bromopropane	10.18
2-bromopropane	10.075
1,3-dibromopropane	10.07
1-bromobutane	10.13
2-bromobutane	9.98
1-bromo-2-methylpropane	10.09
2-bromo-2-methylpropane	9.89
1-bromopentane	10.10
HI	10.38
I <sub>2</sub>	9.28
methyl iodide	9.54
diiodomethane	9.34
ethyl iodide	9.33
1-iodopropane	9.26
2-iodopropane	9.17
1-iodobutane	9.21
2-iodobutane	9.09
1-iodo-2-methylpropane	9.18
2-iodo-2-methylpropane	9.02
1-iodopentane	9.19
F <sub>2</sub>	15.7
HF	15.77
CFCI <sub>3</sub> (Freon 11)	11.77
CF <sub>2</sub> Cl <sub>2</sub> (Freon 12)	12.31
CF <sub>3</sub> Cl (Freon 13)	12.91
CHClF <sub>2</sub> (Freon 22)	12.45
CFBr <sub>3</sub>	10.67

**TABLE VIII**  
**ALIPHATIC ALCOHOL, ETHER, THIOL,**  
**AND SULFIDES**

Molecule	IP (eV)
H <sub>2</sub> O	12.59
methyl alcohol	10.85
ethyl alcohol	10.48
n-propyl alcohol	10.20
i-propyl alcohol	10.18
n-butyl alcohol	10.04
dimethyl ether	10.00
diethyl ether	9.53
n-propyl ether	9.27
i-propyl ether	9.20
H <sub>2</sub> S	10.46
methanethiol	9.440
ethanethiol	9.285
1-propanethiol	9.195
1-butanethiol	9.14
dimethyl sulfide	8.685
ethyl methyl sulfide	8.55
diethyl sulfide	8.430
di-n-propyl sulfide	8.30

TABLE X

## ALIPHATIC ACIDS AND ESTERS

Molecule	IP (eV)
CO <sub>2</sub>	13.79
formic acid	11.05
acetic acid	10.37
propionic acid	10.24
n-butyric acid	10.16
isobutyric acid	10.02
n-valeric acid	10.12
methyl formate	10.815
ethyl formate	10.61
n-propyl formate	10.54
n-butyl formate	10.50
isobutyl formate	10.46
methyl acetate	10.27
ethyl acetate	10.11
n-propyl acetate	10.04
isopropyl acetate	9.99
n-butyl acetate	10.01
isobutyl acetate	9.97
sec-butyl acetate	9.91
methyl propionate	10.15
ethyl propionate	10.00
methyl n-butyrate	10.07
methyl isobutyrate	9.98

**TABLE XII**  
**OTHER ALIPHATIC MOLECULES WITH N ATOM**

Molecule	IP (eV)
nitromethane	11.08
nitroethane	10.88
1-nitropropane	10.81
2-nitropropane	10.71
HCN	13.91
acetonitrile	12.22
propionitrile	11.84
n-butyronitrile	11.67
acrylonitrile	10.91
3-butene-nitrile	10.39
ethyl nitrate	11.22
n-propyl nitrate	
methyl thiocyanate	10.065
ethyl thiocyanate	9.89
methyl isothiocyanate	9.25
ethyl isothiocyanate	9.14

**TABLE XIV**  
**SOME DERIVATIVES OF OLEFINS**

<b>Molecule</b>	<b>IP (eV)</b>
vinyl chloride	9.995
cis-dichloroethylene	9.65
trans-dichloroethylene	9.66
trichloroethylene	9.45
tetrachloroethylene	9.32
vinyl bromide	9.80
1,2-dibromoethylene	9.45
tribromoethylene	9.27
3-chloropropene	10.04
2,3-dichloropropene	9.82
1-bromopropene	9.30
3-bromopropene	9.7
$\text{CF}_3\text{CCl}=\text{CClCF}_3$	10.38
$\text{n-C}_5\text{F}_{11}\text{CF}=\text{CF}_2$	10.48
acrolein	10.10
crotonaldehyde	9.73
mesityl oxide	9.08
vinyl methyl ether	8.93
allyl alcohol	9.67
vinyl acetate	9.19

TABLE XVI  
AROMATIC COMPOUNDS

Molecule	IP (eV)
benzene	9.245
toluene	8.82
ethyl benzene	8.76
n-propyl benzene	8.72
i-propyl benzene	8.69
n-butyl benzene	8.69
s-butyl benzene	8.68
t-butyl benzene	8.68
o-xylene	8.58
m-xylene	8.58
p-xylene	8.445
mesitylene	8.40
durane	8.025
styrene	8.47
α-methyl styrene	8.35
ethynylbenzene	8.815
naphthalene	8.12
1-methylnaphthalene	7.96
2-methylnaphthalene	7.955
biphenyl	8.27
phenol	8.50
anisole	8.22
phenetole	8.13
benzaldehyde	9.53
acetophenone	9.27
benzenethiol	8.33
phenyl isocyanate	8.77

**TABLE XVII**  
**MISCELLANEOUS MOLECULES**

Molecule	IP (eV)
ethylene oxide	10.565
propylene oxide	10.22
p-dioxane	9.13
dimethoxymethane	10.00
diethoxymethane	9.70
1,1-dimethoxyethane	9.85
propiolactone	9.70
methyl disulfide	8.46
ethyl disulfide	8.27
diethyl sulfite	9.68
thiolactic acid	10.00
acetyl chloride	11.02
acetyl bromide	10.55
cyclo-C <sub>6</sub> H <sub>11</sub> CF <sub>3</sub>	10.46
(n-C <sub>3</sub> F <sub>7</sub> )(CH <sub>3</sub> )C=O	10.58
trichlorovinylsilane	10.79
(C <sub>2</sub> F <sub>5</sub> ) <sub>3</sub> N	11.7
isoprene	9.08
phosgene	11.77

TABLE XVIII (continued)

Species	Photoionization Sensitivity*
propylene	4.0
mineral spirits	4.0
2,3-dichloropropene	4.0
cyclohexene	3.4
crotonaldehyde	3.1
acrolein	3.1
pyridine	3.0
hydrogen sulfide	2.8
ethylene dibromide	2.7
n-octane	2.5
acetaldehyde oxime	2.3
hexane	2.2
phosphine	2.0
heptane	1.7
allyl chloride (3-chloropropene)	1.5
ethylene	1.0
ethylene oxide	1.0
acetic anhydride	1.0
$\alpha$ pinene	0.7
dibromochloropropane	0.7
epichlorohydrin	0.7
nitric oxide	0.6
$\beta$ pinene	0.5
citral	0.5
ammonia	0.3



## 5.2 Disassembly of Instrument

**PROBE** - Turn the function switch to the OFF position and disconnect the probe connector from the readout unit. Remove the exhaust screw found near the base of the probe (see Figure 8.) Grasp the end cap in one hand and the probe shell in the other, and gently pull to separate the end cap and lamp housing from the shell. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber doesn't fall out of the end cap and the lamp doesn't slide out of the lamp housing. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out in your hand. Place one hand over the top of the lamp housing and tilt slightly; the light source will slide out of the housing. The amplifier board can be removed from the lamp housing assembly by unsnapping the coaxial connection and then removing the retaining screw.

To reassemble this unit, first slide the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, checking to make sure that the contacts are properly aligned. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the 'O' ring. DO NOT OVERTIGHTEN. Line up the pins on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. DO NOT FORCE the assembly into the shell as it only fits one way.

**READOUT UNIT** - Turn the function switch to the OFF position and disconnect the probe from the readout unit before disassembly is conducted (see Figure 10). Remove the accessory power jack plug. Loosen the screw on the bottom of the case and, holding the instrument by the bezel, remove the case. The power supply board and control panel can be removed by unscrewing two screws and two nuts. The entire panel, including the function switch, zero and span pots is removed in this operation. Electrically disconnecting this module is simple, since all connections are made with Molex connectors.

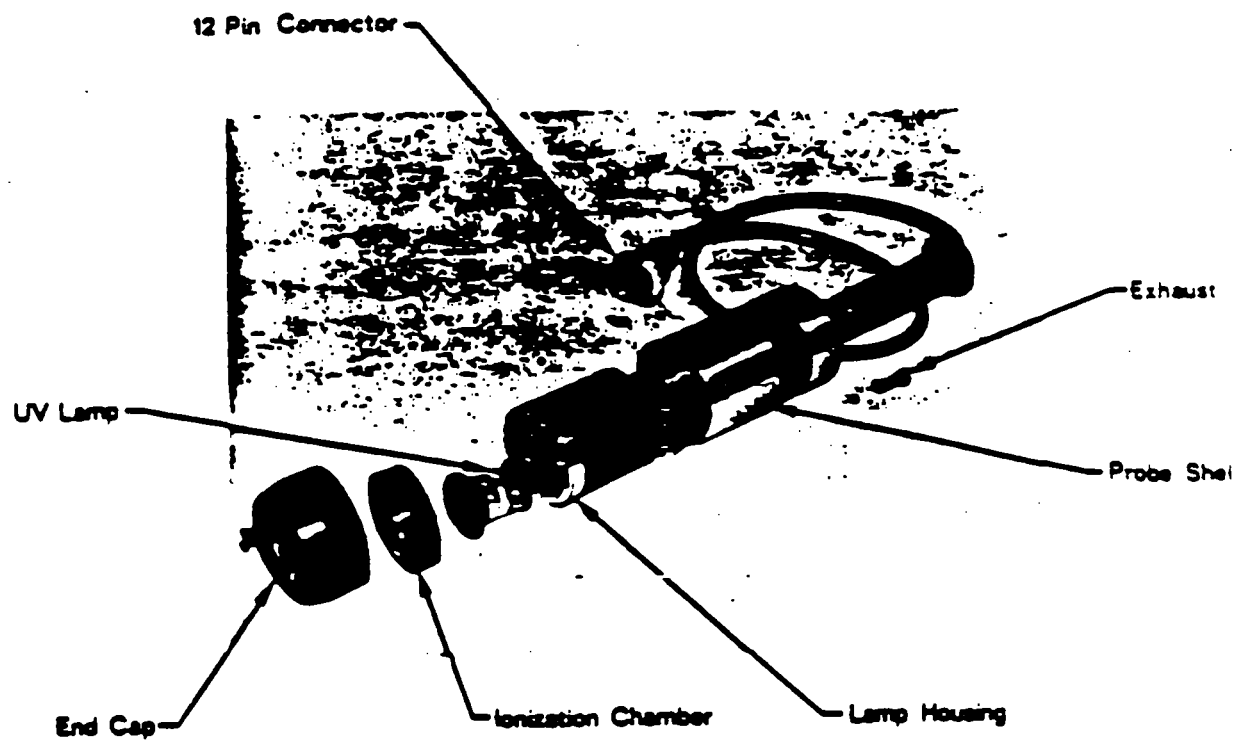


Figure 8. Component Parts of Probe

### 5.3 Specific Faults

1. No meter response in any switch position (including BATT CHK)
  - A. Broken meter movement
    - (1) Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.
  - B. Electrical connection to meter is broken
    - (1) Check all wires leading to meter and clean the contacts of quick-disconnects.
  - C. Battery is completely dead
    - (1) Disconnect battery and check voltage with a volt-ohm meter.
  - D. Check 2 amp fuse
  - E. If none of the above solves the problem, consult the factory.
2. Meter responds in BATT CHK position, but reads zero or near zero for all others
  - A. Power supply defective
    - (1) Check power supply voltages per Figure 11. If any voltage is out of specification, consult the factory.
  - B. Input transistor or amplifier has failed
    - (1) Rotate zero control; meter should deflect up/down as control is turned.
    - (2) Open probe. Both transistors should be fully seated in sockets.
  - C. Input signal connection broken in probe or readout
    - (1) Check input connector on printed circuit board. Should be firmly pressed down.
    - (2) Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object.
    - (3) Check all wires in readout for solid connections.
3. Instrument responds correctly in BATT CHK, AND STBY, but not in measuring m
  - A. Check to see that light source is on (See General Faults section.)
    - (1) Check high voltage power supply (see Figure 11).
    - (2) Open end of probe, remove lamp and check high voltage on lamp contact ring.
    - (3) If high voltage is present at all above points, light source has most likely failed. Consult the factory.

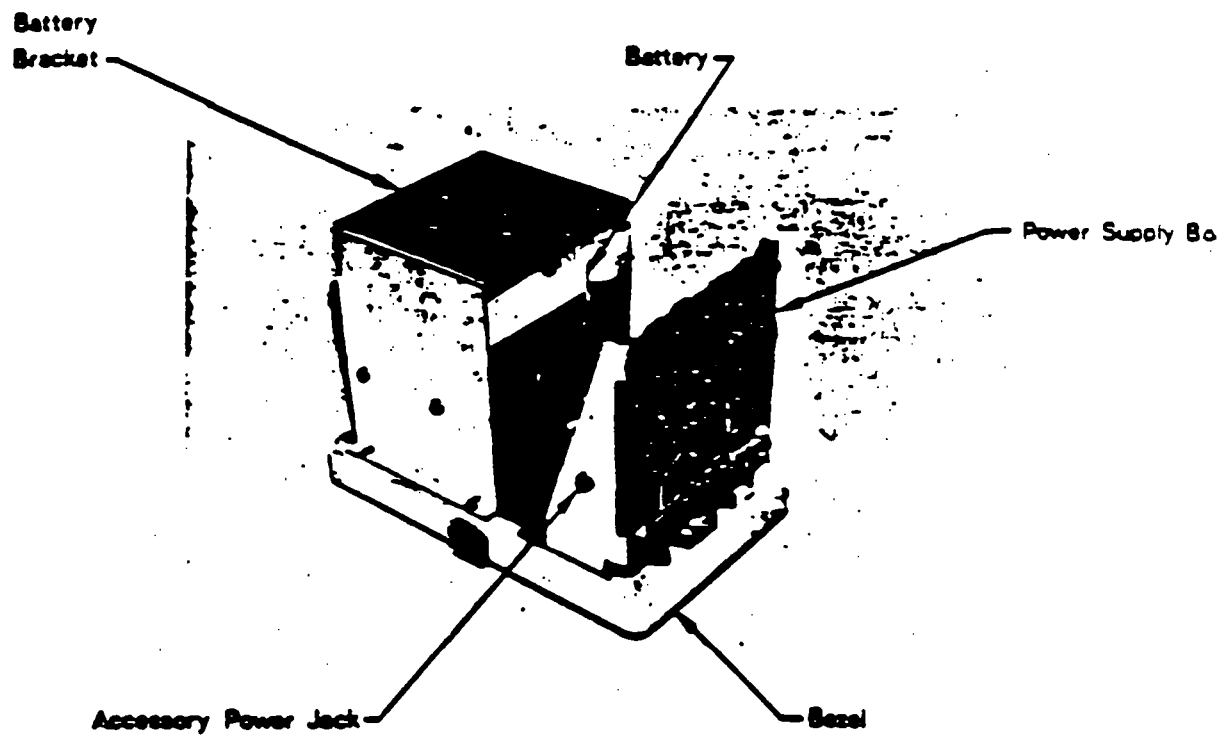
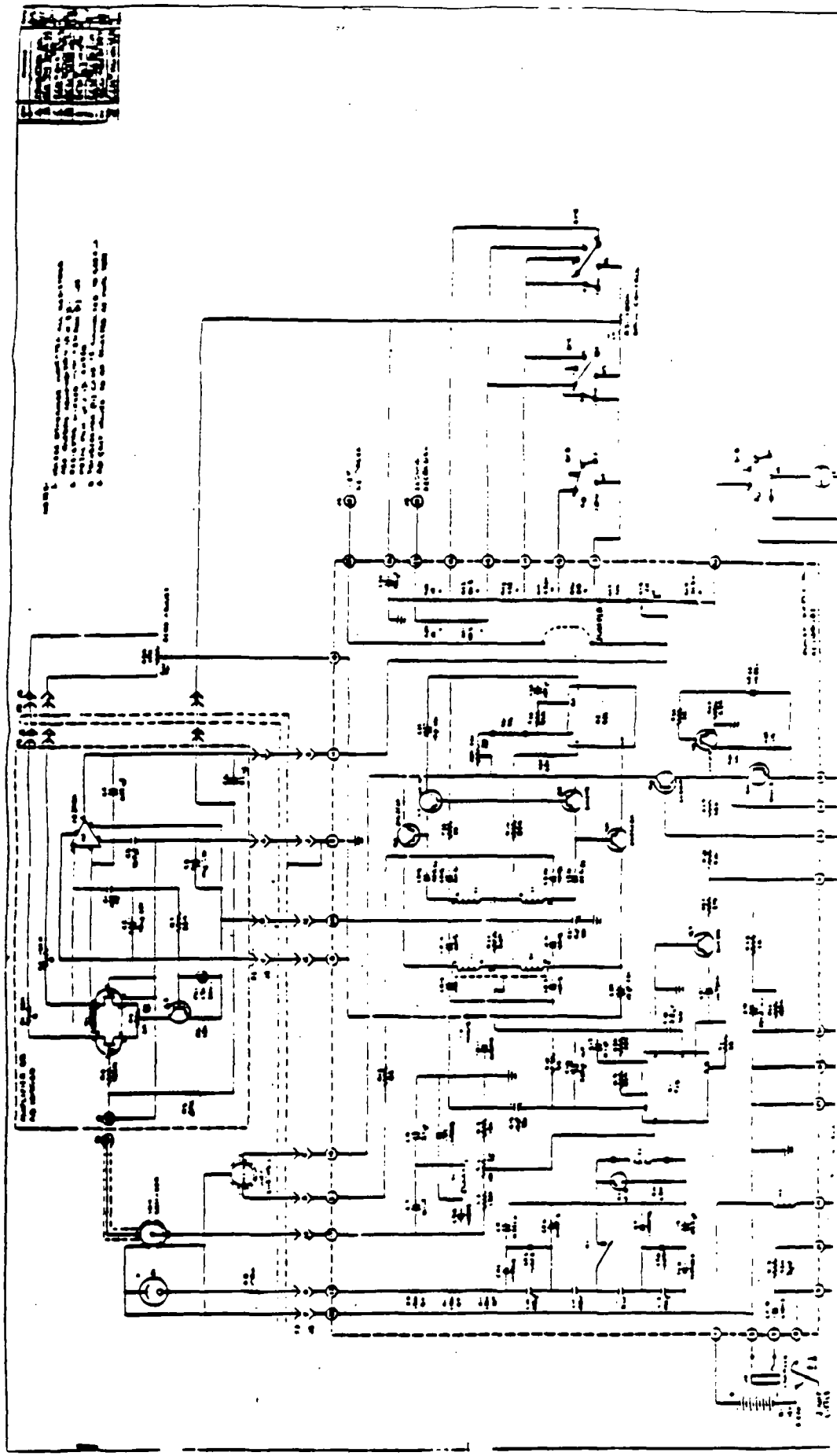
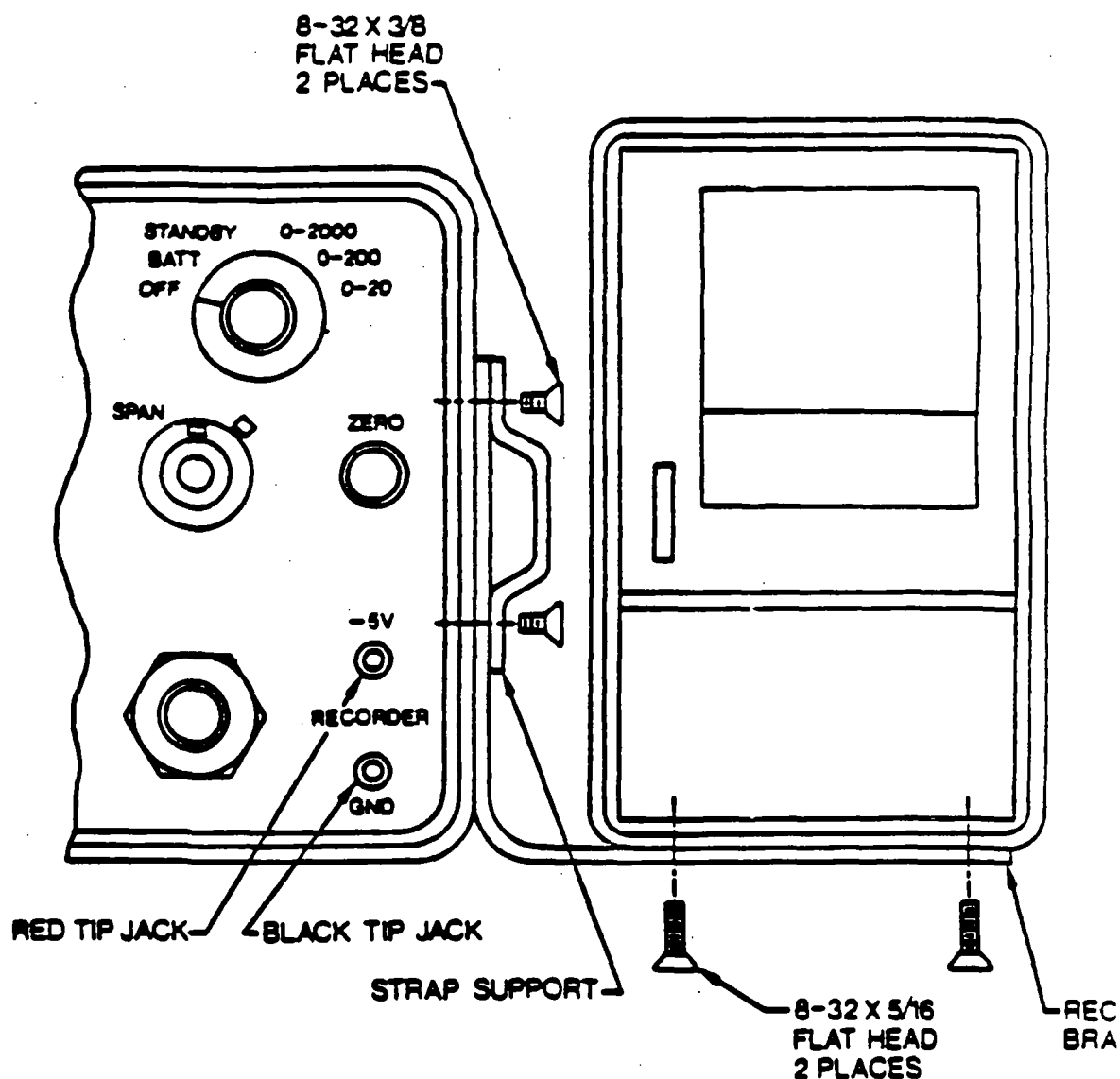


Figure 10. Component Parts Of Readout Unit.



SECTION 8  
PI-101 RECORDER ASS'Y  
INSTRUCTIONS



**NOTES:**

1. Remove strap support on right side of PI-101 case.
2. Mount recorder bracket between case & strap support using 8-32 X 3/8 long screws supplied.
3. Mount recorder to bracket using 8-32 X 5/16 screws supplied.
4. Connect harness to plug on rear of recorder. Insert power plug into receptacle on side of case. Insert red pin plug into red tip jack and black pin plug into black tip jack on PI-101 front panel.

ADDENDUM A  
to  
Instruction Manual  
for  
Model PI 101  
PHOTOIONIZATION ANALYZER

ION CHAMBER CLEANING PROCEDURE

Although the technique of photoionization is not sensitive to moisture, some electronic instability can be seen in the 101 portable analyzer as the result of excessive moisture. The following chart lists the symptoms expected, the possible causes, and solutions:

<u>Symptom</u>	<u>Possible Cause</u>	<u>Solution</u>
Loss in sensitivity	Condensation on instrument window	Avoid extreme temperature changes
		Acclimatize instrument to environment
Zero drift	Condensation on polarizing electrode	"
	Ion chamber is dirty	Clean ion chamber

To clean the ion chamber: (See Section 5.2)

Remove the ion chamber. Remove all four screws, swing screen aside, and pull out the mesh. Using a Q-tip, gently clean the chamber with methanol to remove deposit. Dry in a vacuum oven at 90°C for 2 hours. Reassemble.

PART		DESCRIPTION
1		PI 101 Analyzer, S/N _____
1		Calibrated Probe with _____ eV S/N _____
1	100013	Battery Charger _____ V, S/N _____
1	100018	Waist Strap
1	102175	Probe Extension

PI 101 ACCESSORIES SHIPPED

QUANTITY	PART	DESCRIPTION
	101-350	Span Gas Cylinder _____
	7022-LC3-03V	Regulator for Span Gas Cylinder
	#288	Bustrak Portable Recorder
	100394	Recorder Bracket
	100378	Recorder Wiring Harness
	8-32 X 5/16" F.H.	Screws for Recorder Bracket
	8-32 X 1/8" F.H.	Screws for Recorder Bracket
	MA Gulton	Chart Paper (3 rolls per pkg)
	101-500	Lamp Cleaning Compound
	100009	Spare 9.5 eV Lamp
	100009	Spare 10.2 eV Lamp
	100009	Spare 11.7 eV Lamp
	100112	Calibrated probe w _____ eV lam S/N _____

COLLATERAL PARTS SHIPPED:

INSPECTOR: \_\_\_\_\_  
DATE: \_\_\_\_\_  
PACKER: \_\_\_\_\_





**APPENDIX D**

**INSTRUCTION MANUAL FOR  
DRT-15 C PORTABLE TURBIDIMETER**

**INSTRUCTION MANUAL  
DET-15 C  
PORTABLE TURBIDIMETER**

**HF scientific, inc.  
3052 Metro Parkway, S.E.  
Fort Myers, FL 33916-7539  
Phone: (813) 337-2116  
FAX: (813) 332-7643**

**DET-15C (9/88)**

DRT TURBIDIMETERS  
OPERATING INSTRUCTIONS

FOREWORD

The DRT Turbidimeters are continuous reading Nephelometric instruments which measure scattered light from particles in suspension in a liquid. The optical signal is stabilized and amplified to energize a meter. The instruments use solid state electronic components and resist thermal variation and lamp aging.

All modes of the DRT Turbidimeter Instruments provide a display of turbidity in Nephelometric Turbidity Units. Note that (Jackson Turbidity Units), FTU (Formazin Turbidity Units) and (Nephelometric Turbidity Units) are comparable.

The material contained in this manual will help the users to full advantage of the instruments in the majority of applications. However in event that unusual circumstances or problems not covered in this manual arise, please contact your local distributor or manufacturer.

HF scientific, inc.  
3052 Metro Pkwy, SE  
Fort Myers, Florida 33916-7539  
Phone: (813) 337-2116  
FAX: (813) 332-7643

Our engineering staff is available to help you with your special needs.

DRT-15C (9/88)

### III. PRE-OPERATION CHECK OUT

Extreme care should be taken when handling the Reference Standards or sample cuvettes as surface scratches or finger smudges cause analysis errors. Handle these items by the top only.

Turn the Range Switch on to either range position in order to observe the condition of the battery. When sufficiently charged the red low battery light will be OFF. If the light is ON the battery should be charged a minimum of 12 hours before using instrument on battery power.

The battery, when new, usually requires several cycles of charging and recharging in order to obtain optimum rated capacity between charges. NOTE: The turbidimeter is not meant to be removed from the charger. If the battery does not have a sufficient charge, the red low battery light will be ON.

The turbidimeter provides up to 4 1/2 hours of continuous operation as a portable battery operated unit between recharges.

This unit does not require any warm up time before taking readings. It is recommended that the unit be turned off between readings in order to obtain longer battery life between recharges. If used as a stationary unit, leave the charger plugged in. This will keep the battery at an optimum level at all times.

## VI. CRITICAL MEASURING AREA

The critical measuring area of the sample containers is the wide band starting  $5/8"$  above the bottom. Keep this area and free of scratches or abrasion. Handle by the top part (See Figure 1).

GLASS SAMPLE  
CONTAINER  
28 MM O.D.

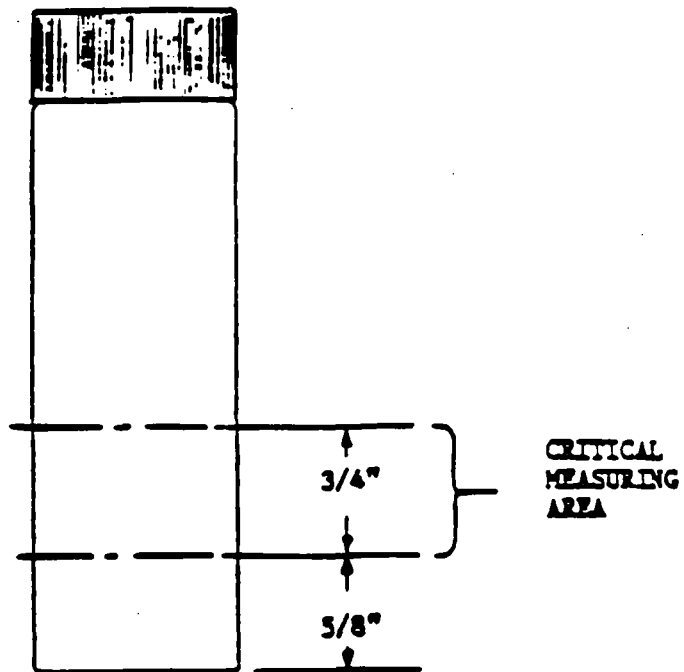


Figure 1

DRT-15C (9/88)

**B. ELECTRONIC CALIBRATION USING FRESHLY PREPARED FORMAZIN SOLUTIONS**

The DRT Turbidimeters have been carefully calibrated by factory. However, should the Electronic P.C. Board, Photo Detectors, or the Light Source be replaced or if carefully prepared Formazin suspensions indicate a need recalibration, this may be easily accomplished in facility.

To carry out a complete calibration the following Formazin suspension values are required:

- |           |   |                                    |
|-----------|---|------------------------------------|
| 198 NTU , | - | Fill, cap and label a separate     |
| 19.8 NTU  |   | cuvette with a sample of each.     |
| & 2.0 NTU |   |                                    |
|           | - | Always mix the contents of each    |
|           |   | cuvette by inverting several times |
|           |   | before placing in the Optical Well |
|           |   | for a reading.                     |
|           | - | Keep the outside surface of        |
|           |   | cuvettes clean.                    |
|           | - | When placing any standards in the  |
|           |   | well, always use the Light Shield  |
|           |   | to cover the well in order to keep |
|           |   | out ambient light.                 |

To gain access to the trimpots, remove the accessories from foam holder. Refer to figure 2 for trimpot identification and the next few steps.

- 1) Center the reference adjust control on top of the instrument.
- 2) Insert the reference standard and turn the range control on the DRT-15C to the 20 range. Adjust the "Course trimpot (R2) until a reading of 0.10 NTU is obtained.
- 3) Replace the reference standard with the 19.8 NTU standard and adjust the "20 Range Adjust" trimpot (R7) to obtain a reading of  $19.8 \text{ NTU} \pm 0.1 \text{ NTU}$ .
- 4) Replace the 19.8 NTU formazin standard with the reference standard and adjust the reference adjust control to obtain a reading of 0.10 NTU.
- 5) Repeat steps 3 and 4 until no further adjustments are required.
- 6) Turn the range control on the DRT-15C to the 200 range. Insert the 198 NTU formazin standard and adjust the "Range Adjust" trimpot to obtain a reading of  $198 \pm 1 \text{ NTU}$ .

This completes the calibration of the DRT-15C.

**DRT-15C (9/88)**

## VIII. TROUBLE SHOOTING

### Symptom

Meter does not respond when a sample is set into the well.

### Possible Cause

1. Lamp is burnt out. Lamp should be replaced.
2. Printed Circuit Board faulty. Replace Printed Board.
3. Battery is dead. Replace battery.

In the case of 1 or 2 the instrument should be recalibrated lamp is an exceedingly long life lamp and therefore replacement is infrequent.

### Symptom

Reference Adjust knob does not have enough travel to adjust the reference standard value.

### Possible Cause

1. Scratched or rubbed reference standard container or reference standard. Replace the standard.
2. Optics have aged. Recalibrate.
3. Faulty lamp. Replace the lamp and recalibrate.

### Symptom

The display will not stabilize when the reference standard is set into the well.

### Possible Cause

1. Light shield is incorrectly placed over the well.
2. Battery has lost its charge. Low battery light is ON battery requires recharging. When the battery is charged, the voltage will drop off causing the meter display to drift.
3. Cold sample causes condensation on cuvette which affects light reading being received by the detectors.
4. Unit has not been given sufficient time to stabilize ambient temperature conditions after a change of temperature.



## **I. PARTS & ACCESSORIES**

HF scientific, inc.  
PARTS AND ACCESSORIES FOR  
DRT-15 C

### **CATALOG NO.**

### **DESCRIPTION**

60002	Reference Standard 0.1 NTU
50083	Instruction Manual (DRT15C)
50051	Cuvettes - Screw Top, 3/pk
21084	Lamp Source Assembly
70006	Battery - 6 volt
70048	Battery Charger - 115 volt
50009	Light Shield
20850	Photo Diode
70020	Battery Charger, 230 Volt
20742	LED Display
50076	Printed Circuit Complete
50040	Formazin Stock Solution Kit
70900	Cuvette Cleaning/Conditioning Solution

HF scientific, inc.  
3052 Metro Parkway, S.E.  
Fort Myers, FL 33916-7539  
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FAX: (813) 332-7643

DRT-15C (9/88)



**TECHNICAL SPECIFICATIONS STATEMENT**

**FOR**

**SOIL GAS SURVEYS**



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## FIELD PROCEDURES

### Scheduling

TARGET normally dispatches a field crew to any North American site within 2-3 days after receiving client authorization, and following markout of underground utilities and receipt of Health and Safety information, if applicable. The company also maintains an emergency response capability. Field personnel and equipment, from both the Columbia, Maryland and Huntington Beach, California offices, are mobilized to project locations by company-owned vehicle or, where appropriate, by commercial air carrier and rental vehicle. Weather conditions are rarely an obstacle to fulfilling scheduled survey times and requirements.

The field sampling phase is expedited to limit the effects of changing atmospheric and soil conditions; to limit interference with site activities or business operations; to minimize daily costs; and to prevent delay of the client's other investigation or remedial operations. On a typical survey, a sample collection rate of 40-80 samples per day is the norm for a two-man field crew. For larger projects with accelerated or short-fused deadlines, TARGET dispatches multiple field teams.

### Survey Design and Layout

Upon arrival on a project site, TARGET field personnel examine the location to verify that all underground utilities and other buried structures have been properly marked and identified (crews are equipped with line detectors as an added precaution). A general Health and Safety reconnaissance of the site is performed using appropriate air monitoring equipment. The accuracy of any pre-existing site map is verified at this time as well.

Following the site reconnaissance, an accurate site map, which includes all sampling points as well as important physical features and landmarks reflecting actual site conditions, is carefully constructed (or validated) using tape and compass survey procedures. The sampling points (each marked with a wire pin-flag or paint) are typically spaced 30-100 feet apart and are laid out over the property in accordance with the pre-survey design as approved by the client. Each sampling pattern, however, is site-specific and designed to address the particular questions pertinent to each site. A regular rectilinear grid is often the best pattern of coverage, with particular attention to the areas around any suspected contamination sources.

### Sampling Methodology

Depending on the site conditions and the survey objectives, TARGET can offer three levels of sampling depth capability. Samples of soil gas are most commonly obtained from a depth of about 4 feet. For most projects of this type, TARGET uses hand-held equipment, such as a heavy-duty manual plunger bar or an electric rotary hammer drill equipped with a special drive rod, to produce each 1/2" diameter sampling hole. In the event asphalt or cement pavement, gravel fill, or other hard surfaces are encountered,

## ANALYTICAL PROCEDURES

On routine projects, once field operations and sampling have been completed each day, the samples are immediately transported by the field crew or shipped by overnight courier to the main laboratory for analysis. Where appropriate, however, samples may be analyzed during the course of field sampling by TARGET's mobile laboratory facilities or by a portable GC.

TARGET's dedicated laboratory facilities are equipped with Hewlett Packard 5890 gas chromatographs interfaced with an HP Series 9000 computer and Series 300 chemstation. The lab uses contaminant-specific detectors, following strict QA/QC procedures and standard EPA 601 and 602 methodologies. For the analysis of petroleum products, a flame-ionization detector (FID) is used. The analysis of chlorinated hydrocarbons is performed with an electron capture detector (ECD). A mass spectrometer (GC/MS) is available for the confirmation of unusual or "unknown" contaminants which appear on the chromatograms. The lab is equipped to analyze 300 soil gas samples per day.

The company's mobile laboratory is climate controlled and contains high-grade analytical equipment identical to that in the main laboratory. The mobile laboratory is equipped to analyze 50 soil gas samples per day and may be used when same-day results and quality "real time" data are required.

TARGET's laboratory quality analytical facilities are capable of detecting, discriminating, and measuring concentrations of many volatile organic compounds. A listing by analysis in TARGET's lab of some of the more common compounds and their detection limits are presented in Tables 1-3.

Concentrations for each compound detected are calculated based on the peak areas on the chromatograms. TARGET's technical staff examines in detail the individual sample chromatograms to decipher the signatures or peak areas characteristic of the specific hydrocarbon analytes detected.

As an example of its analytical capabilities, TARGET is not limited to reporting only standard hydrocarbon compounds such as benzene, toluene and xylenes, but can also detect the paraffins and cyclo-paraffins which comprise a substantial volume of fresh gasoline in the vapor phase. The GC/FID is typically standardized and calibrated to quantitatively detect MTBE (a gasoline additive), benzene, toluene, ethylbenzene and ortho-, meta-, and para-xylene. Each of these compounds behaves differently in the subsurface due to differences in their volatility, water solubility, and octanol-water partition coefficients. As a result of these different chemical and physical properties, each compound can offer significant insight into what has occurred in the subsurface of a contaminated site - e.g. source of the contamination, presence of multiple sources, relative age of the product (weathering effects), migration patterns, etc.

TARGET also maintains portable GC equipment to conduct in-field analysis for projects requiring on-site data to reach the desired goals of the investigation. The in-field portable GC, while not as informative as the laboratory GC, is capable of providing limited on-site data to guide field activities such as emergency responses, remedial clean-up, and possible groundwater plume tracking where sampling approaches may need to be modified by the on-site data. Upon reviewing specific site information, TARGET would evaluate the appropriateness of using the portable GC in the field.

## ANALYSIS BY GC/FID

<u>VOLATILE ORGANIC COMPOUNDS</u>	<u>DETECTION LIMITS (ug/l)</u>
Acetone	1.0
Benzene	1.0
1-Butanol	1.0
2-Butanol	1.0
Chlorobenzene	1.0
Ethylbenzene	1.0
Isopropyl Ether (IPE)	1.0
Methyl Ethyl Ketone (MEK)	1.0
Methyl Isobutyl Ketone (MIBK)	1.0
4-Methyl-2-Pentanone	1.0
Methyl-Tert-Butyl Ether (MTBE)	1.0
1-Propanol	1.0
2-Propanol	1.0
Toluene	1.0
Meta- & Para-Xylene	1.0
Ortho-Xylene	1.0

The following compounds are also analyzed using GC/FID; however, a different column is used for the analysis.

<u>VOLATILE ORGANIC COMPOUNDS</u>	<u>DETECTION LIMITS (ppb)</u>
i-Butane	1.0
n-Butane	1.0
Ethane	1.0
Ethylene	1.0
Methane	1.0
Propane	1.0
Propylene	1.0

TABLE 2

## QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

### Field Operations

The following list outlines the minimum required QA/QC guidelines which have been established by TARGET to ensure accurate and reliable results from the soil gas samples collected during the field phase of the survey.

- Special precautions are taken in the selection and design of sampling equipment and supplies to avoid any material that could potentially contaminate or react with the soil gas chemical constituents.
- Sampling apparatus are decontaminated internally and externally prior to and after each day's field activities, and whenever deemed appropriate during the sampling process.
- The entire sampling system is purged between each sampling point. The sampling probe and apparatus, including tubing, valves and injection needle, are purged with a volume of filtered ambient air or pre-purified grade nitrogen approximately 70 times the void space capacity prior to each sample extraction.
- Each field tech is trained by TARGET for a six month period to conduct soil gas surveys and to collect representative soil gas samples.
- Just prior to taking an actual soil gas sample, the sampling apparatus is purged with one (1) sampling system volume of in-situ soil gas. This in-situ soil gas, which is pulled into the system through the probe, is used to purge the atmospheric or nitrogen air from the sampling equipment, preventing dilution of the actual soil gas sample. The gas is then vented into the atmosphere.
- To confirm quality, field control blanks of pre-purified grade nitrogen or ambient air filtered through a dust and organic vapor filter cartridge are obtained at the beginning of each day's sampling activities, after every twentieth (20) sample, and at the conclusion of each survey phase. These field control samples are labeled and analyzed in the same manner as and are visually indistinguishable from the actual field samples.
- Sample inventories are counted and checked prior to leaving the field site. They are also checked and verified prior to and after transport to the analytical laboratory. A Chain of Custody form, on which there is an itemized log of all samples, is used to track each point of custody exchange.
- When transporting the soil gas samples to the analytical facility, whether by the field crew members or overnight courier service, the sample vials are securely packaged in a protective container to prevent damage.



## **INTERPRETATION AND REPORTING**

The field notes, data, and sample chromatograms for each project are examined and interpreted by TARGET's technical staff of geologists, chemical engineers, soil scientists and hydrogeologists. All soil gas data require interpretation in order to clarify the meaning of the variations in compound concentrations and material compositions across a site. TARGET's technical staff has extensive experience in the analysis and interpretation of this data and has the capability to identify for the client those important features or results of the soil gas survey which will impact other phases of the site assessment project.

Following this review and interpretation, the data and results are fully integrated into a formal comprehensive written report. Three (3) copies of this report are distributed to the client by overnight courier within 7 to 10 days following the completion of field sampling. If desired, verbal reports are also available within 3-4 days of sample collection. The written report prepared by TARGET provides:

- an executive summary
- an introduction (site background, purpose of survey)
- documentation of field and laboratory procedures as well as QA/QC procedures
- tables of all analytical and QA/QC results
- details of the survey and site conditions
- discussion and interpretation of results, including (if applicable):
  - description of individual analyte occurrences
  - likely on- or off-site sources
  - relative aging of the contaminant(s) based on degree of weathering
  - migration patterns
  - characterization of different products or source events
- a series of two-color, compound-specific isoconcentration maps of total volatiles and each key analyte, revealing the differences in occurrence and behavior of the various compounds in the subsurface.
- other illustrations, as appropriate, to clarify interpretations and conclusions

The reports are written, compiled and published at TARGET's corporate headquarters in Columbia, Maryland. The report writing and preparation efforts are supported by a computer-aided graphics department which is responsible for generating the report maps.